CHILD WELL-BEING IN KOREA

By

PARK, KYOUNGMI

DISSERTATION

Submitted to
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ABSTRACT

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This dissertation evaluates the effect of policies for children in South Korea focusing on the case of teenagers. This dissertation consists of three chapters. The first chapter evaluates the impact of a school counseling program called Wee Class by using Difference-in-Differences analysis. The second chapter tries to find the correlation between air pollution and teenager's subjective well-being within the Two-Stage Least Squares, and discusses policy implication. Lastly, the third chapter measures multicultural children's subjective well-being affected by Korea's multicultural policy within the individual fixed effect. These studies found the positive impact of school counseling program on students' school adaptation, the negative effect of air pollution on teenager's subjective well-being, and the positive impact of multicultural policy on multicultural children's subjective well-being in elementary school.

Keywords: Wee Class, School counseling program, Air pollution, Particulate matter, Multicultural policy for children, School adaptation, Children's subjective well-being, Multicultural children's subjective well-being, NAEA, KCYPS, MAPS

Dedicated to
My husband, Lim, Chae Suk

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Chapter 1

The Impact of School Counseling Program on Students' School Adaptation

Abstract

This paper evaluates the impact of a school counseling program in middle and high school designed to improve students' school adaptation in South Korea. The program is not mandatory for schools and approximately 54% of all schools nationwide had implemented the program as of 2016; students thus have varying durations of exposure to the program when moving up from elementary school to high school. Exploiting the difference of individual's exposure to the program, this paper studies the program's impact by Difference-in-Differences (DID) analysis with individual fixed effect, using the National Assessment Education Achievement (NAEA) data collected in the years 2013 and 2015 (N=429,314). This paper found that middle school intervention and continuous intervention from middle to high school both had a significantly positive impact on students' adaptation to high school, while the intervention only in high school seemed to have no impact.

This study in chapter one was conducted by analyzing the panel data of National Assessment Education Achievement (2010 cohort; 2010-2013-2015/ 2011 cohort; 2011-2014-2016) with the support of the "2018 research of the Customer-Centered Information Service System for the National Assessments" conducted by the Korea Institute of Curriculum and Evaluation. 이 논문은 2018 년 한국교육과정평가의 "국가단위 평가의 수요자 중심 정보 활용 서비스 시스템 연구"의 지원을 받아 국가수준학업성취도 평가의 (2010-2013-2015/ 2011-2014-2016) 연계 자료를 분석하여 수행하였다.

1.1. Introduction

The recent OECD reports on students' well-being emphasize the importance of investment in non-cognitive factors to enhance students' present and future well-being, stating that it is crucial for schools to foster psychologically, socially and physically enriching environment in which students can achieve balanced growth, in addition to academic achievement (OECD, 2017). However, schools in South Korea have continued to use an academically focused approach to make students future-ready. Recently, school dropout rates in South Korea have surged. A large proportion of students who dropped out of the school claimed that they experienced difficulties in finding the true meaning of school learning (Ministry of Education, 2016).

Despite the social pressure on schools to emphasize academic achievement, South Korean education policy has been working on strategies to support students' psychological well-being, help them find motivation for achievement and cope with school-related anxiety. In an effort to address these issues, a systemic design for students' well-being in South Korean schools, the School Safety System (also known as the Wee Project; Wee is an acronym for We, Education and Emotion) has been implemented since 2008. It is expected that providing in-school non-cognitive support that is accessible to all students may improve the school environment and help students adapt to school life. The system offers counseling, various extracurricular activities, and educational services based on school networking, provided by regional education bureaus and the provincial office of education. The goals of this system were to reduce school dropout rates and enhance students' school adaptation.

The Wee Project consists takes a three-layer approach to achieve these goals; Wee Class, Wee Center, and Wee School. Wee Class, as the first layer of the Wee Project, is a school counseling service available at elementary, middle and high schools, providing individual, group, and career counseling programs as well as various extracurricular activities. Conversely,

Wee Center and Wee School are both located outside the school grounds, and target students with severe school adaptation problems (Korea Education Development Institute, 2016). Thus, as an in-school, easily accessible counseling service, Wee Class serves as a preventive measure against possible challenges to school adaptation for all students in participating schools (Choi et al., 2011; Korea Education Development Institute, 2011).

Wee Class is widely regarded as successful in the short-term (up to two years) in enhancing students' school adaptation, resulting in improvements in both academic performance and emotional stability of students (Kim & Kim, 2014; Sim, 2017). Besides, there is a growing body of evidence for the causal link between children's emotional and academic productivities during their childhood and adolescence and their future ability to become a productive, financially independent member of society. This further reinforces the importance of the non-cognitive approach in formal education. (Becker, 1994; Gamboa, Rodríguez-Acosta, & García-Suaza, 2013; Heckman, Humphries, & Veramendi, 2018). However, despite the positive impact of Wee Class and supportive evidence, Wee Class has not been mandatory for schools due to budget, space and personnel-related constraints. Students thus have different years of exposure to the program when moving up from elementary school to high school, depending on whether or not their school had a Wee Class.

Emerging evidence suggests that an individual's future adaptive behaviors are formed by early adolescence. In addition, these behaviors seem to persist despite age and changes in environment (Kim & Kim, 2018; Lee, 2016). Specifically, Kim and Kim (2018) found that various aspects of school adaptation, including learning habits, attitude, and peer and teacher relationships observed among 7th grade students persisted until the 9th grade (Kim & Kim, 2018). Lee (2016) described how anti-social behaviors such as beating, burglary, sexual violence and truancy get worse when young people transition into high school, and how it weakens individuals' sociality (Lee, 2016). Moreover, for students in their late teens, the

influence of their level of school adaptation may be much more direct and significant since they are on the cusp of adulthood (Lipscomb, 2007). In sum, these results indicate that it is both necessary and more effective to implement the program for students' school adaptation in earlier life stages, considering the persistence of the effect of school adaptation and its impacts on later life.

Therefore, it is fair to assume that early exposure to Wee Class could help address the challenges of school adaptation for students in their late adolescence. While previous studies have been done on the effect of Wee Class for the purpose of policy analysis, they only examined its short term impacts, were limited to certain regions, or used subjective data such as reported program satisfaction (Kim & Kim, 2014; Sim, 2017; KEDI, 2011). The effects of an early introduction of Wee Class, which may affect students' later development the most, have not been sufficiently studied.

This paper examines how the effects of Wee Class differ when introduced at different times by evaluating the level of school adaptation in high school. The data for this study is National Assessment of Educational Achievement (NAEA), which contains nationwide academic achievement and survey data of students in the 9th grade (3rd grade in Korean middle school), and the 11th grade (2nd grade in Korean high school). In addition to the impact of Wee Class intervention in middle school (early intervention), this study explored the differences in the extent of the impact depending on the period of intervention, comparing later, early, and continuous intervention. 'Early intervention' refers to cases that of intervention exclusive to the middle school years, 'later intervention' denotes intervention during high school, and 'continuous intervention' describes cases of both middle and high school intervention. To minimise the potential confounding effect of inter-school differences (Dobbie & Fryer, 2014; Hahn, Wang, & Yang, 2018), the data was restricted to students who had graduated from general middle school and continued on to general high school, general high schools being

schools that offer education in various fields without specialization, accounting for over 90% of all high schools in South Korea (Kim et al., 2013; Enforcement Decree of the Elementary and Secondary education Act of 2019). The dependent variable, school adaptation, was differentiated to internal impact and external impact. Internal impact represents 'Attitude towards Learning' (Lee, 2005; Lee & Kim, 2008; Spencer, 1999) and 'Attitude towards School' (Kwak, 2012); external impact represents 'Standardized Academic Achievement' (Kim & Kim, 2014; Gamboa et al., 2013; Sim, 2016; Spencer, 1999). Difference-in-Differences analysis using individual fixed effects was implemented for this study (Angrist & Pischke, 2008). The results demonstrated that both early and continuous intervention of Wee Class had significant positive effects on school adaptation during the high school period. However, there was no significant impact in the case of later intervention.

This paper is organized as follows: section 1.2 explores the theoretical framework and literature; section 1.3 reports the data and methodology; section 1.4 analyzes the empirical results; section 1.5 contains the conclusion and interviews with school counselors.

1.2. Theoretical Framework and Literature

1.2.1. Students' Development in Ecological System

Supporting the development of a wide range of capabilities, including both cognitive and non-cognitive skills, is the approach to childhood development most supported by current scientific research on the subject (Araujo, Gottlieb, & Moreira, 2007; Heckman, Stixrud, & Urzua, 2006). This method entails a much more inclusive attitude compared to the traditional approach of education that focused almost exclusively on cognitive aspects (Becker, 1994; Hansen, Heckman, & Mullen, 2004; Suri, Boozer, Ranis, & Stewart, 2011).

Comprehensive efforts to improve children's cognitive and non-cognitive abilities require the strong interaction among the various settings in children's environment. These settings can

include family, friends, and other relevant institutions (Benson et al., 2004; Heckman et al., 2006; Conti & Heckman, 2016). Bronfenbrenner's ecological systems theory (Bronfenbrenner, 1979) is a clear illustration of this phenomenon. His theory presents four different ecological systems: the microsystem, mesosystem, exosystem and macrosystem. The microsystem is a person's most immediate environment with which they experience regular direct contacts, such as home, school, and playground. The mesosystem is defined as the interactions and interconnections between two or more microsystems that influence each other, such as parent-teacher relations, peer relations, and neighborhood interactions. The exosystem represents places that affect the person even though they are not actively involved, such as their parents' workplace. Finally, the macrosystem is defined as all-encompassing, including elements that affect all settings. Examples of macrosystem components include culture, norms and traditions. In addition, all the settings within the environment interact and adjust to each other, leading to the balanced development of children (Bronfenbrenner, 1979).

School is one of the most important settings in students' ecological systems. Besides receiving official education, many formative experiences for students occur at school, as this is the space where the majority of their time is spent. However, since students have different backgrounds (parents and socioeconomic status), the standardized educational environment cannot fit all students. Some students face difficulties in relationships with peers as well as experiencing school-related anxiety (McMahon, Mason, Daluga-Guenther, & Ruz, 2014). An academic-centered environment in school can further exacerbate these conditions (Heckman et al., 2006). In severe cases, or when these issues remain unaddressed, students are more likely to become involved in school violence, drop out of school, and, in extreme cases, choose to commit suicide (KEDI, 2015).

From the perspective of ecological systems, schools need to provide interventions that can mitigate emotional disturbances by taking a holistic approach to effectively support balanced

growth, giving due consideration to the interconnected roles of school, students and other settings in students' environment such as parents, siblings, friends, and teachers (Conti & Heckman, 2016; Sink, 2005). A school counseling program can act as a single, multifaceted strategy that can enhance students' non-cognitive aspects by understanding and interconnecting students' diversity in their environment. Counseling is known to be effective in fostering the development of students' internal assets such as motivation and pro-active engagement in school life that can naturally improve their educational outcomes (Adeyemo, 2005; Galassi, 2017; Learner & Kruger, 1997; Spencer, 1999).

1.2.2. Wee Project (School Safety Net)

Wee Project is a systemic school counseling network (also known as a school safety net) wherein schools, regional education bureaus, and provincial office of education collaborate to improve the quality of students' school life. Launched in 2008 as a presidential election pledge project, Wee Project commenced the implementation of its programs in October of that year, aiming to foster an educational environment helping students cope with the difficulties of school adaptation. This educational policy provides students with counseling and general support regarding school-related anxiety (Hyun, 2018; Sim, 2017). Until 2011, Wee project was a pilot program financed by the national budget. Since 2012, however, it has switched to funding by 17 provincial offices of education (Choi et al., 2011).

The Wee Project 'school safety net' has three layers: Wee Class, Wee Center, and Wee School. The first layer, Wee Class, is implemented in school as a counseling office open for all students providing individual and group counseling, as well as program-based services. The aims of Wee Class are to serve as a prevention mechanism for school maladjustment and to help students adjust better to school life by minimizing the difficulties that can surface as students go through each developmental stage of their lives (Choi et al., 2011; Korea

Educational Development Institution, 2016). In addition, each program aims to help all students develop academically as well as push for positive changes in the quality of schools and students' experience of education (Choi et al., 2011).

The second layer of Wee Project, Wee Center, is set up in regional education bureaus by establishing stakeholder networks within the community to provide more specified counseling service. Thus, students in need of special counseling can be connected to their local Wee Center. Lastly, Wee School is a collection of long-term commissioned boarding schools located in their respective provincial office of education, meant for high-risk student groups, providing therapy as well as academic courses (Korea Educational Development Institution, 2016). In sum, Wee Center and Wee School are focused on high-risk students and are located outside school grounds, while Wee Class is located on school grounds and offers basic counseling accessible all attending students.

<Table 1-1> Structure of Wee Project (School Safety System)

Wee Project		Location	Intervention	Function
1	Wee Class	School	Universal	Targeting all students at school Early detection and prevention of problems among students, helping enhance school adaptation (Core function: guidance directing advice)
2	Wee Center	Regional Education Bureaus	Selective	Targeting at-risk students Diagnosis-counseling-treatment one-stop service for students who need to be maintained by experts (Core function: counseling collaboration conversation)
3	Wee School	Provincial office of Education	Indicated	Targeting high-risk students Long term commissioned boarding school for students in high-risk students who need to heal in the long term (Core function: psychotherapy, curing, and rehabilitation)

Note: This table is constructed based on the theoretical background from Choi et al. (2011).

1.2.3. Wee Class as the First Layer of Wee Project

As the first layer of Wee Project, Wee Class is installed in schools. And it provides all the students with diverse preventive work based on counseling. When Wee Class was first introduced in 2008 and up until 2011, the rate of Wee Class implementation in schools of all levels was under 23%. Since 2012, however, education bureaus in 17 provinces have allocated funds from the local budget for the operation of Wee Class, resulting in a significant increase in Wee Class implementation (see Table 1-2). However, the implementation of Wee Class is not mandatory for schools in South Korea. Consequently, approximately 45% of South Korean schools (total number of elementary, middle, and high schools) still do not implement Wee Class (Korea Educational Statistics Service, 2018).

<Table 1-2> Number of Wee Class Implementation

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016
School(N)	11,080	11,160	11,237	11,317	11,360	11,408	11,446	11,526	11,563
Wee Class(N)	530	1,530	2,530	3,170	4,658	4,904	5,633	6,161	6,245
Ratio	4.78	13.71	22.51	23.01	41	42.99	49.21	56.45	54.01

Note: The data is combined information from the Korean Educational Development Institute (2016), the Korean Educational Statistic Service (http://kess.kedi.re.kr), and the Wee Project Website (http://www.Wee.go.kr). In the first row, 'School' represents the total number of schools in South Korea including elementary, middle, and high school. The second row represents the total number of Wee Class. Lastly, the ratio is calculated by; Wee Class/ number of School.

Generally, once school install Wee Class, one counselor is in charge of one Wee Class per school. Their official role is to help students by forming a cooperative relationship with class homeroom teachers (Choi et al., 2011; Korea Education Development Institute, 2016), as well as conducting their own counseling programs. According to an interview with school counselors conducted from June 11th to June 20th, 2019, the Wee Class programs directed by school counselors can be categorized into individual counseling, group counseling, psychological test, and program-based services. The contents of each category were diverse

but most programs were matched with the 'Wee Project manual I - Wee Class' generalized guidelines. An example of a Wee Class annual program provided by 'Wee Project manual I - Wee Class' and 'the contents of the interview with school counselors' can be found in Appendix A.

School counselors are either faculty members or those who have completed teaching courses and received counselor certification. School counselors are divided into grades I and II (grade I is higher level). Those who completed either a master's course in counseling or a special counseling course in the graduate school of education are classed as Grade I. Grade II counselors are those who studied counseling at university (Elementary and Secondary Education Act, 2019). Other counselors fulfilling the same roles (hereafter general counselors) are those who have completed the national social welfare certificate, youth counselors, clinical counselors or those who have obtained counseling-related certification from a private institution (KEDI, 2015). The number of schools with general counselors in charge of Wee Class is double the number of schools where school counselors are in charge.

1.2.4. School Adaptation

School adaptation, within the educational production function, is a critical outcome achieved by students. School adaptation is affected by students' non-cognitive and cognitive abilities, which can be measured by actual outcomes, such as academic attainments, their behaviors and their mindset. Spencer (1999) conceptualized school adaptation as a combination of academic motivation, academic achievement, school engagement, persistence, school attendance, learning readiness and school completion, defining it as a requirement for maximizing the educational fit between the student's qualities and the multidimensional character of learning environments. Kwak (2006) described school adaptation as the active process of balancing the school environment between school and students' interests. Moreover, Kim (2015), who

developed a measure of school adaptation in middle and high schools, outlined school adaptation as the dynamic relationship between students and the school environment based on academic achievement, psychological stability, school relations, and school life.

Studies dealing with school adaptation usually use students' behavior, educational attainment and emotional stability as outcome variables. In the case of students' behavior, relevant studies have measured changes in the frequency of tardiness and disciplinary action, as well as the number of absences (Lee & Kim, 2008; Park, 2013). In order to measure positive behaviors, student conduct in class and compliance with school rules were evaluated. Students' behavior during learning activities was also considered as part of a general assessment of students' non-cognitive academic motivation (Kim & Kim, 2018; Lee et al., 2016; Park, 2013). On the other hand, educational attainment, as an outcome, can be measured directly using standardized scores or students' self-reported satisfaction with their academic results (Sim, 2017; Kim & Kim, 2018). Lastly, when measuring school satisfaction, which determines whether or not students enjoy school life, and students' relationship with peers and teachers have been used as the core outcome variable (Kwak, 2006; Lee et al., 2016; Lee, 2017; Park, 2013).

Previous literature has demonstrated that school adaptation could be enhanced by educational quality, including inputs such as school budget, teacher abilities, and school facilities (Ellison & Swanson, 2016; Gigliotti & Sorensen, 2018; Hanushek, 1998; Hahn et al., 2018; Paik, 2013). However, the relationship between student's school adaptation and the school's capital is neither unique nor robust. For this reason, non-cognitive factors are increasingly being used as important inputs in educational quality. These inputs include psychological programs, mentoring, and information about the way of studying (Gamboa et al., 2013).

Extensive studies on non-cognitive support have shown positive effects on students'

academic achievement. Rodriquez-Planas (2012) found that mentoring-based educational services alongside financial incentives had a significant positive impact on school graduation rates of high school students when the service was offered to low-performing high school students for four years in the US. In addition, strategies such as giving students simple advice on studying methods (Lin-Siegler et al., 2016), making students aware of similarities between them and their teachers (Gehlbach et al., 2016), and sharing positive text messages with students (Brid, Castleman, Goodman, & Lamberton, 2017) were all found to improve school grades and some were even found to reduce school dropout rates (Yeager et al., 2014). In particular, enforcing positive personal values among young students in middle school resulted in a definite increase in academic achievement (Cohen et al., 2006, 2009; Dee, 2015; Sherman et al., 2013; Yeager et al., 2014).

1.2.5. The Effect of Wee Class on School Adaptation

As a nationwide student counseling program, Wee Class is also expected to contribute to improving education quality (Choi et al., 2011). The programs in Wee Class are expected to function as a form of 'nudge intervention through non-cognitive approach'. This approach involves showing young people their potential options, helping them navigate an uncertain future and motivate themselves to seek better solutions for their learning habits and emotional status without authoritative or prescriptive counseling, as well as engaging them with various activities (Damgaard & Nielsen, 2018; Kim & Kim, 2014; Korea Educational Development Institute, 2011; Leonard, 2008; Thaler & Sunstein, 2008).

This non-cognitive supports has been measured by the changes of school adaptation. Sim (2016) used data from the Seoul Education Longitudinal Study in her analysis focusing on middle school students experiencing difficulties in school adaptation. She divided the data into three groups: the first group consisted of students with two years of experience in Wee Class; the second and third group included students with one year of Wee Class experience and

students who had never been exposed to Wee Class, respectively. After matching the characteristics of each group by using propensity score matching, she used the Ordinary Least Squares (OLS) method and found that students from the first group (2 years of Wee Class experience) experienced a significant positive impact on school adaptation, academic achievement, and were less likely to be involved in school violence compared to students in the other groups.

Other studies have also corroborated the effectiveness of Wee Class. Kim and Kim (2014), using data from School Information Disclosure, demonstrated that high school students with over two years of Wee Class experience show significantly higher academic performance and a significantly lower risk of engaging in school violence compared to those who did not have Wee Class experience. However, in the case of schools that operated Wee Class for less than one year, both Sim (2016) and Kim and Kim (2014) found that these positive changes did not occur. Besides, from the school level perspective, Kim et al. (2016), in their data analysis with the National Assessment of Educational Achievement (NAEA), demonstrated an inverse correlation between academic underachievement and the duration of Wee Class operation at schools, with underachievement rates falling as the duration of Wee Class operation increased.

Based on this research, it can be concluded that the initial stage of operating Wee Class (around the one year mark) on its own is insufficient to produce a measurable impact on students' school adaptation. Conversely, it is possible to produce a measurable effect once it enters into what can be called the stable phase (around the two years mark), at which point Wee Class intervention not only positively affects students as individuals, but also impacts school culture as a whole and can improve the efficacy of Wee Class itself.

However, previous studies done on the impact of Wee Class on school adaptation have used either exclusively short-term data or participants' satisfaction survey data, both of which have limitations concerning its capacity to confirm the importance of the intervention stage of Wee

Class and its' long-term effect. Thus, this study, using NAEA data, categorize students based on when, and how consistently they experienced Wee Class in order to find out how different time of intervention influences students' school adaptation.

1.3. Data and Methodology

1.3.1. Data

This study used the National Assessment of Educational Achievement (NAEA), 2010 cohort collected by Korea Institute for Curriculum and Evaluation. NAEA is an annual evaluation of the trends in the academic achievement of Korean students, conducted to enhance the education curriculum. Shortly after its introduction, data was only collected based on a selected sample. However, the sample size was gradually expanded such that by 2009, the assessment had become a complete enumeration. The NAEA collected data from nationwide 6^{th} (elementary school), 9^{th} (middle school), and 11^{th} (high school) graders. When individual became the final participants (in their 11^{th} grade), the previous data is merged with current data by using the individual's ID (Park et al., 2017; Kim et al., 2016).

For the main analysis, 2013 (9^{th} grade) and 2015 (11^{th} grade) in cohort 2010 were used since there was no information of Wee Class in 2010 (6^{th} grade). And cohort 2011 is used for robustness check later in the analysis. <Table 1-3> shows each wave of two cohorts.

<Table 1- 3> National Assessment of Educational Achievement (NAEA) Data

Cohort	Wave
Cohort 2010	2010(6^{th} grade) – 2013(9^{th} grade) – 2015(11^{th} grade)
Cohort 2011	2011(6^{th} grade) – 2014(9^{th} grade) – 2016(11^{th} grade)

Note: NAEA is a cross-section data collected from 6^{th} grade, 9^{th} grade, and 11^{th} grade students nationwide. When an individual became the final participants in the survey and national assessment (in their 11^{th} grade), the previous data is merged with current information by using the individual's ID. Therefore this data is in the form of panel data.

The wide panel data was reshaped into longitudinal panel data, and to minimize the confounding effect of school differences, the data set was limited to students who had graduated from general middle school and entered general high school; general schools follow the national curriculum, while specialized (middle/high) schools are able to apply an independent curriculum. For the purpose of precise analysis, whether or not a school is running Wee Class and the year Wee Class was introduced were both taken into consideration. In other words, when the NAEA was done for 9th graders on 25 June 2013, students had been studying approximately for two years and five months in the middle school. Because the middle school period in South Korea is three years, from 7th grade to 9th grade. Therefore 9th grade students at the time of NAEA can be said that they experienced the Wee Class for two years and five months in the middle school. However, some schools of the data installed Wee Class in the school when students became the second semester of the 7th grade or the 8th grade. In this study, if any of the students in that middle school had been exposed to the program for less than two years and five months, they were not considered for the sample. The same criteria were used for students in high school. Specifically, students who had experienced Wee Class for the entire duration of high school as of 23 June 2015 were selected. Also, students who had never experienced Wee Class in both middle and high school were used as a control group.

<Table 1-4> reports the overview of schools and students taking part in Wee Class. Among the 2,127 middle schools from the data set used for this analysis, 994 schools had never operated Wee Class, whereas 1,133 schools had provided the Wee Class program for students in middle school for two years and five months. The Wee Class period is not specially reported in the data. But 2.5 years are estimated by the installation year of Wee Class, which school installed it before that the students enter the middle school or in the same year of students' entrance of the middle school. Regarding the high school level, of the 1,554 schools from the data set, 475 schools had not offered Wee Class, and 1,079 schools among them had run the

program approximately for one year and five months before the NAEA test date. The period of Wee Class in the high school; 1.5 years is also estimated by the installation year of Wee Class in high school.

<Table 1-4> Number of Wee Class Implementation in the School

Wee Class	Wee Class in Middle Schools (N)		Wee Class in High Schools (N)	
	School	Student	School	Student
No	994	81,559	475	101,190
Yes	1,133	165,653	1,079	286,449
Total (N)	2,127	267,212	1,554	387,639

Note: The number of schools and students in the table is only considering the students who have studied in schools where Wee Class was implemented during the entire school period or those who never experienced Wee Class. Since middle school and high school are both three years in South Korea, students who received Wee Class intervention during the enitre middle school period, will have received approximately 2.5 years of Intervention as of the time of taking the national exam (NAEA), which was taken at the end of first semester in their 3rd grade of middle school (9th grade in the US education system). In case of high school, students had been receiving the treatment approximately for 1.5 years by the time of taking NAEA, which was taken at the end of first semester in their 2nd grade of high school (11th grade in the US education system). As additional information, the South Korean education system consists of Elementary school (6 years), Middle school (3 years) and High school (3years). Each year has two semesters; one starts from March and ends in July, and the second semester lasts from September to December. The NAEA and the student Survey was conducted at the end of the first semester, in June.

<Table 1-5> outlines whether or not individual students were exposed to Wee Class during middle school, high school, or both. Based on these criteria, individual students were divided into four groups. Group1 consisted of 34,175 students who were exposed to Wee Class only during middle school, Group2 was comprised of 46,530 students who were exposed to Wee Class during high school only, and Group3 represents 116,060 students who had a Wee Class in both middle and high school. Finally, the control group represents students with no prior experience of Wee Class, neither during middle school nor high school, and contained 17,892 students.

The schools excluded from the sample are special purpose high schools, science high schools, foreign language high schools, art high schools, specialized high schools, experience-oriented education, and autonomous high schools (hereafter Specialized high school) (Enforcement

Decree of the Elementary and Secondary Education Act, 2019). Those who attend Specialized high schools generally have higher academic scores and socioeconomic status compared to students attending general high schools. And the specialized schools apply independent curriculum differently from general high school. Therefore, those samples were not considered in the analysis and only used for a robustness check.

<Table 1-5> The Period of Wee Class Intervention

Year	Control Group	Group 1	Group 2	Group 3
2013	C	T	C	T
2015	C	C	T	T
N (Students in General high school) 214,657	17,892	34,175	46,530	116,060

Note: The year 2013 is middle school, 2015 is high school. T refers to treat; whether they had studied in a school which implements Wee Class during the middle school or high school. C refers to Control. Group1 represents those who only experienced Wee Class in middle school, Group2 those who experienced Wee Class in high school, and Group3 those who continuously studied in schools with Wee Class. The students for analysis in <Table 1-5> only considered general high school.

However, it is worth noting that there could be an endogeneity problem and selection bias when analyzing Wee Class implementation. Firstly, there is no information about Wee Class implementation during elementary school in this data. Even though Wee Class was a pilot program until students in this data entered middle school (pilot program period: Oct. 2008-2011), it is still possible that experiencing Wee Class during elementary school affected the outcome, causing an underestimation problem in the main analysis. However, in the main model, by including individual fixed effects, the impact of the latent effect on the outcome could be controlled (Angrist & Pischke, 2008).

Secondly, even though students in general middle schools (except for international middle schools and art middle schools) are randomly allocated within their residential area, some people may argue that students who experienced Wee Class in elementary school are more likely to choose middle schools with Wee Class. In order to check the validity of random

assignments within the middle schools sampled, the correlation between individual characteristics of students and school during elementary school and the Wee Class indicators in middle school was measured. If the early characteristics (especially for elementary school characteristics) are associated with the Wee Class dummy in middle school, there could be a selection bias. Appendix C.1 shows this result of validity test demonstrating that there is no correlation between the elementary school characteristics and the Wee Class dummy in the middle school. However, in the validity test, the school location was a factor for the participation in Wee Class, as students in small and medium-size cities and rural areas were found to be less likely to go to schools with Wee Class comparing to students in the big cities. For this reason, the Further Analysis section checks whether the estimates differed by school location.

The same argument can occur for the admission of high school. However, high school admission is depending on school curriculum system and Wee Class is not a criteria for the school admission. For the general high school admission, if the residential area has an equalization system, students choose several schools in advance, and are allocated to one of those schools on a random basis. If, on the other hand, the residential area does not have an equalization system, school principals may choose their students via their own selection process. In South Korea, most metropolitan cities use an equalization system, namely, Seoul, Incheon (excluding Ganghwa, Ongjin, and Yeongjong), Daejeon, Daeju, Gwangju, Busan and Ulsan. Other provinces also use equalization systems, although they are usually combined with schools' own selection processes.

However, students who choose specialized high school admission select one specific school and subsequently commence the entrance process. In this process, we may assume that students for specialized high school admission may consider school quality such as Wee Class. In addition, those students who choose this process tend to already have higher academic scores

and socioeconomic status (Enforcement Decree of the Elementary and Secondary Act, 2019; Practical Law, 2019). Moreover, specialized high schools offer independent curriculum differed by general high school.

For this reason, even though Wee Class itself was not a criterion for high school admission, this study attempted to prevent any selection bias by only considering students who studied in general middles school and general high school for the analysis.

The third concern comes from Wee Class selection criteria. Schools wishing to set up a Wee Class can apply through regional education bureaus. Some of the criteria considered by bureaus when assessing a school's eligibility for Wee Class are whether the school is situated in a disadvantaged neighbourhood; whether it is capable to allocate space to serve as a counseling office; its ability to hire school counselors, and whether maintaining the program is sustainable considering the conditions of the school. However, in the reality, if a school wishes to install Wee Class, the school plan is usually supported by the regional education bureaus regardless of the selection criteria (Korea Educational Development Institution, 2016).

1.3.2. Methodology

The outcome of interest of this study is to deduce whether students' school adaptation during their high school period was influenced by the difference in the period of Wee Class intervention. Since there are students who had never experienced Wee Class in the middle school to high school period, they were used as a control group and the various Wee Class intervention periods were compared within the model with the control group. This approach is a 'Difference-in-Differences' (DID) model, which compares outcome differences among each group with regard to time changes. The individual fixed effects is used for the DID to remove time-invariant individual characteristics.

Wee Class exposure at school is estimated by the equation below:

$$Y_{igt} = \alpha + \gamma After_t + \delta_1(G_1 \times After_t) + \delta_2(G_2 \times After_t) + \delta_3(G_3 \times After_t)$$
$$+X'_{igt}\varphi + \rho_i + \varepsilon_{igt} \quad (1)$$

G1: Treat only in middle school, G2: only in high school, G3: both in middle and high school

Y_{igt} is the outcome variable of interest corresponding to student *i* in the designated Group g and at the time *t* which is equal to 1 in the high school period, and is equal to 0 if the time is before (i.e., in the middle school period). The main estimates of this model are δ_1,δ_2 and δ_3, that represent the interaction term between each Group and the post dummy $After_t$. X'_{igt} is the vector of controls related to student and school characteristics. ρ_i stands for individual fixed effects, and ε_{igt} is an error term. The indicator for being treated in the designated group was omitted due to the individual fixed effects.

<Table 1-6> presents the dependent variable, school adaptation, which is divided into Internal and External outcomes. The Internal Outcomes consists of 'Attitude towards Learning' and 'Attitude towards School'. Attitude towards Learning describes how much students value studying and their academic motivation (Spencer, 1999; Lee, 2005; Lee & Kim, 2008). The four questions pertaining to Attitude towards Learning were posed to students regarding each of the three main subjects, those being Korean Language, English, and Math. The questions were labeled as the following: Attitude 1 (I enjoy studying), Attitude 2 (I am interested in studying), Attitude 3 (I think studying this (subject) helps with other subjects) and Attitude 4 (Studying will be helpful for the future). The first and second attitudes represent students' academic motivation (Spencer, 1999); the third and fourth attitudes determine the number of values that students hold regarding learning (Lee, 2005; Lee, 2008). The students' responses were measured by a four-point Likert scale: one meaning 'definitely no', two denoting 'probably no', three being 'probably yes', and four signifying 'definitely yes'. Then, each value from the three subjects (Korean Language, English, and Math) was summated for the main analysis. For instance, the maximum value for Attitude 1 (I enjoy studying) is 12 and the

minimum value is 3.

Another outcome is the 'Attitude towards School', which reflects psychological school adaptation, or, in other words, emotional stability (Kwak, 2012). The question posed was if students enjoy going to school. The responses to this question were also measured by a four-point Likert scale: one meaning 'definitely no', two denoting 'probably no', three being 'probably yes', and four signifying 'definitely yes'. Lastly, the External Outcome represents the standardized academic scores for Korea Language, English, and Math (Gamboa et al., 2013; Kim & Kim, 2014; Sim, 2016; Spencer, 1999). The Total Score is the sum of all the scores for Korean Language, English, and Math, and is also standardized.

<Table 1-6> Dependent Variable (School Adaptation)

Dependent Variables		
Internal	Attitude towards Learning (Spencer, 1999; Lee, 2005; Lee & Kim, 2008)	I enjoy studying I am interested in studying I think studying this helps with other subjects. Studying will be helpful for the future.
	Attitude towards School (Kwak, 2012)	I enjoy going to school.
External	Academic Achievement (Spencer, 1999; Sim, 2016; Kim & Kim, 2014)	Korean Language English Math Total Score

Note: The dependent variables are school adaptation which consists of two main aspects; internal and external. The internal aspect is determined by two aspects of students' attitude; one is Attitude towards Learning and the other is Attitude towards School. The external aspect is students' Academic achievement. The detailed item of each aspect is used for dependent variable; Attitude towards Learning (4 items), Attitude towards School (1 item), Academic Achievement (4 items).

<Table 1-7> presents descriptive statistics of the control variables in this analysis. Control variables consist of individual characteristics and school characteristics. In the individual characteristics, Gender is one of the key variables causing variations in students' behavior during adolescence (Morash & Moon, 2007), due to the fact that children tend to receive

different amounts and types of support from their family and school based on their gender, (Figlio, Karbownik, Roth, & Wasserman, 2016). However, in the main analysis, gender was omitted within the individual fixed effects. Hence, the variation in effect by gender is analyzed in the heterogeneity effects. Other aspects of socioeconomic status have also been shown to be important for students' development in previous studies. However, due to lack of relevant information in the data, this study only included the parent dummy (1 is living with both parents, 0 is living with another custodian or single parent) (Griffin et al., 2010; Turner et al., 2016). In order to account for the impact of other program-based services on school adaptation, self-rated school facilities (Figueroa, 2016), extracurricular activities (Tanner, 2017; Marchetti, Wilson, & Dunham, 2016), and other decision processes (Midgley, & Feldlaufer, 1987) in schools were controlled in the model. Lastly, since receiving private lessons (Tomul, & Savashi, 2012) is highly related to academic scores, the level of private lessons measured by a dummy indicator was included.

Various school characteristics were also included to control for confounding effects of inter-school differences. The total number of students and student-to-teacher ratios have both been considered consistently in the literature as factors affecting students' academic achievement (Hanushek, 2016; Gershenson, & Langbein, 2015). The school effect, which includes differences such as coming from a private school (Hahn et al., 2018), and whether a school is single-gender or mixed-gender (Sohn, 2016) has also been discussed as a powerful cause of variation in educational attainments. In addition, the schools within regions with low socioeconomic development had relatively lower academic scores in the previous study (Berger, & Archer, 2016). Therefore, this empirical model tried to include all the possible confounding factors as control variables. However, due to data limitations, the specific district in which schools are located and family background could not be controlled for. However, this study attempts to mitigate the confounding effect of district differences by controlling the size of

districts, categorized as big, small, and rural areas.

<Table 1-7> Descriptive Statistics

Control Variables	Definition
Gender	=1 Female, = 0 Male
Parents	=1 living with both parents, = 0 other custodian or single parent
Satisfaction in School facility	(4 Likert) I like my school because of the facilities.
Extracurricular activity	(4 Likert) I like my school because it offers various extracurricular activities.
Decision making process participation in school	(4 Likert) I like my school because we can be part of the decision-making process.
Private lesson	1. =1 no private lesson / day otherwise 0 2. =1 less than 1 hour / day otherwise 0 3. =1 more than 1 hour less than 2 hours / day otherwise 0 4. =1 more than 2 hours less than 3 hours / day otherwise 0 5. =1 more than 3 hours / day otherwise 0
Number of students	Total number of Students in the school (in the regression 'log of students' used)
Underprivileged students' ratio	Total number of basic living subsidy recipient/ total number of Students in the school
Students/ Teacher ratio	Total number of students/ Total number of teachers
Average Academic score	(Language, English, Math total score) average score of school
Number of Youth program provided in School	Total number of youth programs (club, student council) provided by school
School location	Dummy variables: Big city (Metropolitan area) (1,0) / Small & medium city (1,0)/ rural area (1,0)
School type	Dummy variables: Public (1,0), Private (1,0)
School gender	Dummy variables: Male only school (1,0)/ Female only school (1,0)/ Co-Ed School (1,0)

Note: School information (number of students and teachers, and school characteristics) is from Teacher's survey and it is merged with students' data. The details about dependent variable can be found in <Table 1-6>.

<Table 1-8> reports the summary statistics of this data. Since this study restricted the sample to students who studied in general middle school and general high school, the summary statistics only report information relevant to this analysis. G1 is group1, representing the student group that was exposed to Wee Class only in the middle school; G2 (group2) represents those only exposed to Wee Class in high school; G3 (group3) consists of students exposed to Wee Class in both middle and high school. The mean values of each variable in the control group are generally higher than each sample group (G1, G2, and G3). The detailed summary

statistics of each group can be found in Appendices B.1 and B.2.

<Table 1-8> Summary Statistics

Variables			N	Mean	Std. Dev.	Min	Max
Group	Group1	Intervention in middle school	429,314	0.16	0.37	0	1
	Group2	Intervention in high school	429,314	0.22	0.41	0	1
	Group3	Intervention in both schools	429,314	0.54	0.50	0	1
	Group4	None	429,314	0.08	0.28	0	1
Dependent variables	Internal	Attitude towards Learning 1	426,544	7.5	1.8	3	12
		Attitude towards Learning 2	426,885	7.5	1.8	3	12
		Attitude towards Learning 3	427,220	8.4	1.9	3	12
		Attitude towards Learning 4	427,181	8.6	1.8	3	12
		Attitude towards School	428,211	2.9	0.8	1	4
	External	Total academic achievement	429,314	-0.08	0.95	-3.98	4.04
		Korean Language score	429,004	-0.05	0.97	-3.90	3.77
		English score	429,161	-0.08	0.95	-3.52	3.55
		Math score	428,439	-0.07	0.96	-3.55	3.27
Controls	Students	Gender	429,253	0.5	0.5	0	1
		Parents	429,314	0.9	0.3	0	1
		Facility	427,621	2.7	0.8	1	4
		Extracurricular activity	428,187	2.6	0.8	1	4
		Decision making process participation in school	428,049	2.4	0.9	1	4
		Private lesson 1	429,314	0.3	0.5	0	1
		Private lesson 2	429,314	0.0	0.2	0	1
		Private lesson 3	429,314	0.2	0.4	0	1
		Private lesson 4	429,314	0.2	0.4	0	1
		Private lesson 5	429,314	0.2	0.4	0	1
	School	Number of students	429,314	954.9	335.4	5	1959
		Underprivileged students' ratio	429,314	0.1	0.2	0	1
		Students/teacher ratio	429,314	20.0	4.8	0.625	93.2
		Average academic score	429,314	599.9	46.9	189.3	828.9
		Number of youth activity	429,314	10.0	2.3	0	12
		Metropolitan area	429,314	0.4	0.5	0	1
		Small and medium city	429,314	0.5	0.5	0	1
		Rural area	429,314	0.1	0.3	0	1
		Public	429,314	0.7	0.5	0	1
		Private	429,314	0.3	0.5	0	1
		Male only school	429,314	0.2	0.4	0	1
		Female only school	429,314	0.2	0.4	0	1
		Co-ed school	429,314	0.6	0.5	0	1

Note: Summary Statistics by Groups (Group1, 2, 3, and 4) can be found in the Appendix B.1. And the additional summary statistics for each group during elementary school are in the Appendix B.2.

1.4. RESULTS

1.4.1. The Effect of Wee Class on School Adaptation

<Table 1-9> The Effect of Wee Class Intervention on School Adaptation

Dependent Variable	Attitude towards Learning				Attitude School	Academic Achievement
	Attitude 1	Attitude 2	Attitude 3	Attitude 4		
	(1)	(2)	(3)	(4)	(5)	(6)
Group1 *After	0.040*	0.045**	0.025	0.043*	0.015+	0.015**
	(0.017)	(0.017)	(0.019)	(0.019)	(0.008)	(0.005)
Group2 *After	0.001	0.017	-0.005	0.029	0.009	-0.006
	(0.016)	(0.016)	(0.018)	(0.018)	(0.008)	(0.005)
Group3 *After	0.033*	0.058***	0.021	0.067***	0.018**	0.009+
	(0.015)	(0.015)	(0.016)	(0.016)	(0.007)	(0.005)
After	0.049**	0.056***	0.076***	0.067***	0.015*	0.042***
	(0.016)	(0.015)	(0.017)	(0.017)	(0.007)	(0.005)
Control	Y	Y	Y	Y	Y	Y
FE	Y	Y	Y	Y	Y	Y
_cons	7.786***	8.482***	10.361***	10.631***	2.561***	-5.480***
	(0.297)	(0.294)	(0.326)	(0.327)	(0.136)	(0.105)
N	425,593	425,968	426,244	426,166	426,820	427,171
N(Id)	214,623	214,632	214,635	214,633	214,640	214,645
R-sq.	0.037	0.034	0.028	0.024	0.046	0.027

Note: Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01 ***p<0.001 Group1 experienced Wee Class only during middle school, Group2 experienced Wee Class only in high school, and Group3 is cases that experienced it both in middle and high school. 'After' is the dummy variable; 0 is middle school and 1 is high school years. The data is restricted to students who graduated from a general middle school and went to general high school. Dependent variables are Attitude towards Learning, Attitude towards School, and Academic Achievement. The Attitude towards Learning consists of 4 different measure; **Attitude1**. I enjoy studying, **Attitude2.** I am interested in studying, **Attitude3.** I think studying this helps with other subjects, **Attitude4.** Studying will be helpful for the future. The **Attitude towards School** is measured by I enjoy going to school. And the **Academic Achievement** is sum of three subjects; Korean Language, English, and Math and standardized. The academic achievement from each subject are analyzed in <Table 1-13>. The control variables are students' characteristics, and school characteristics such as number of students, teacher ratio, and the region. The details of control variable can be found in Appendix D.1. The main empirical model with clustered standard errors conducted in Appendix D.2.

<Table 1-9> reports the dissimilarities in different estimates of Wee Class intervention on students' school adaptation. Restricting the sample to students in general high school is expected to minimize any possible confounding effect of school differences on the outcomes

by excluding specialized schools such as science high schools, foreign language high schools and autonomous schools.

All the results in columns (1) through (6) include the control variables and individual fixed effect. Appendix D.1 presents detailed estimates of the control variables. Columns (1) through (4) report the estimates with the dependent variable, 'Attitude towards Learning'. Estimates regarding 'Attitude towards School' is in column (5). Finally, column (6) reports 'Standardized Academic Achievement'.

The first row with Group1 puts forward the hypothesis that Wee Class intervention in the middle school period (early intervention) will have an impact on students' school adaptation in their high school period. In the second row, Group2 reports the impact of intervention during the high school period, and Group3 in the third row presents the impact of continuous intervention from middle school to high school.

Students in Group1, who were exposed to Wee Class during middle school, showed higher on Attitude1 (0.02 SDs), Attitude2 (0.025 SDs), and Attitude 4 (0.024 SDs) during high school (11^{th} grade) than students who had never been exposed to the program. Attitude towards School (I enjoy going to school) in column (5) and the Academic achievemment in column (6) also shows a positively significant impact. However, the result for Attitude 3, which was a relatively objective question regarding studying, was insignificant.

The treated duration in Group1 is approximately two years and five months before taking part in the survey. This period is longer than the period used in the previous studies by Sim (2016) and Kim and Kim (2014). When considering the findings in Group1 in conjunction with the results of previous studies, it can be concluded that once students have experienced Wee Class for more than two years during middle school (early intervention), their school adaptation will lead to an optimistic in general, on their high school years.

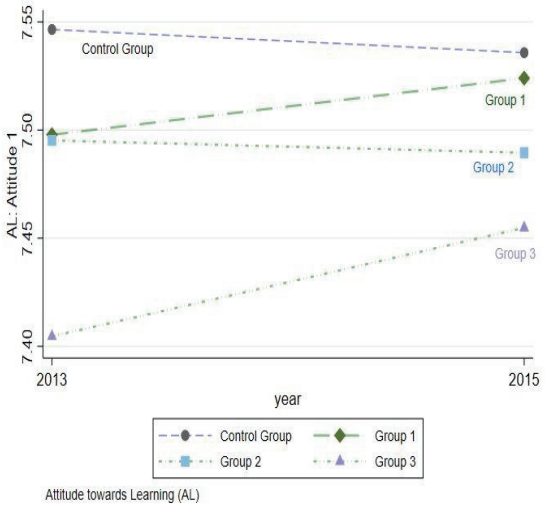
The second row in <Table 1-9> presents the estimates for Group2, comprised of students

whose first exposure to Wee Class occurred in high school (later intervention). This Group does not show significant changes compared to the control groups. On the other hand, the continuous intervention, represented in the third row, reaffirms the positive impact of Wee Class on students' school adaptation. Except for Attitude1 and Academic achievement, the other estimates in Group3 exceeded those in Group1. The difference between the treatment and the control groups in Group3 was in the 0.02 to 0.04 standard deviations range: Attitude1 (0.02 SDs), Attitude2 (0.032 SDs), Attitude4 (0.04 SDs), Attitude School (0.02 SDs.).

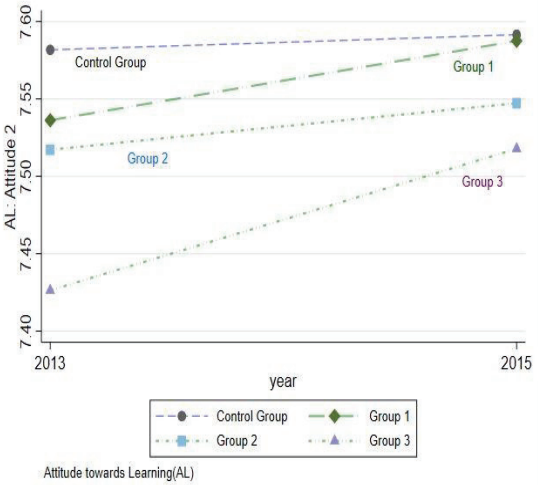
In sum, the results from <Table 1-9> are more encouraging for an early intervention during middle school, as an early intervention seems to have the most significant positive effect on later school adaptation in high school. This is represented by a positive coefficient and a higher conventional significance level. In addition, since the coefficients of Group3 are not much different from those of Group1, the strongest positive impact on school adaptation in the high school period could be a result of intervention during middle school. In addition, given that intervention during high school did not have a significant impact, it is necessary to check whether the programs operating in Wee Class are appropriate to effectively address issues specifically related to the high school level development stage and the particular challenges and anxieties that high school students experience. For this reason, this study included an interview conducted with school counselors, which is summarized in Appendix A.3 and Section 1.5. Conclusion.

Figures (1) through (6) clearly illustrate these impacts and positive changes between each group and control group. In the figures, students in Group3 generally show the lowest school adaptation among Groups in the year 2013. However, within the decreasing or increasing trend, the mean value of Group1 (middle school intervention) and Group3 (continuous intervention) show a clear increase comparing to the control group.

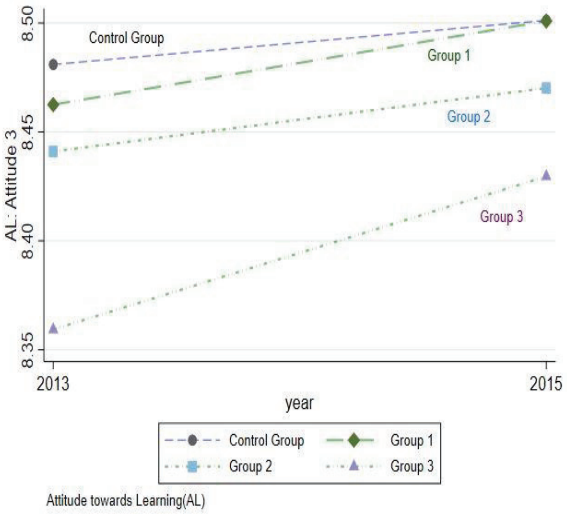
<Fig. 1 -1>
Attitude 1: I enjoy studying



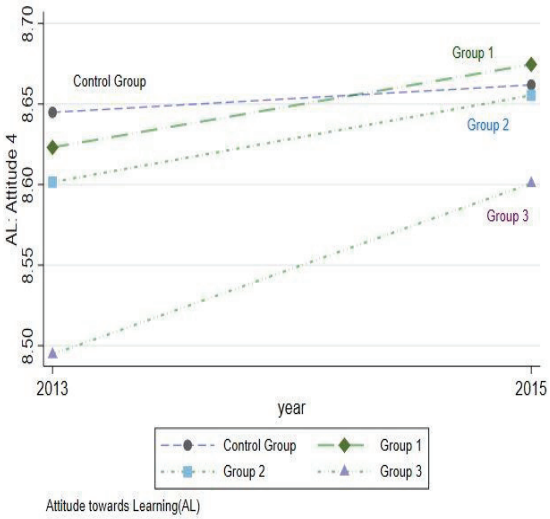
<Fig. 1-2>
Attitude 2: I am interested in studying



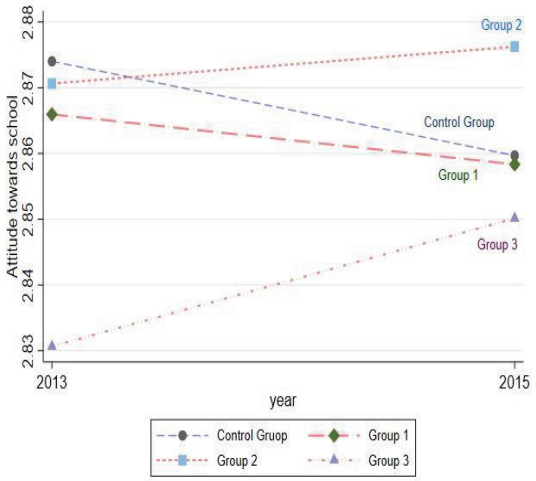
<Fig. 1-3>
Attitude 3: I think studying this helps with other subjects



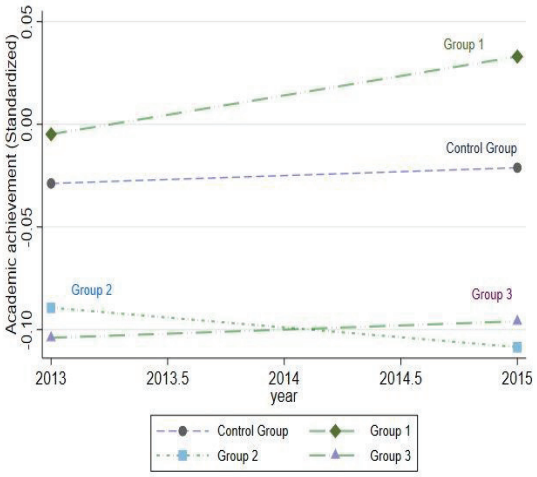
<Fig. 1-4 >
Attitude 4: Studying will be helpful for the future



<Fig. 1-5>
Attitude towards School



<Fig. 1-6>
Academic Achievement



1.4.2. Further results

This section reports on further results that build on the main findings. Firstly, to explore the internal validity of the results presented thus far, robustness checks, using the full data set and different cohorts from the main data, are conducted. In addition, this section examines whether the effects of Wee Class differed by the sub-divided outcomes, school-based academic level, school location and students' gender to address any remaining omitted variable concern due to lack of individual information in NAEA.

A. Robustness Check

<Table 1-10> verified that the estimates in the main model are robust across the entire data set (including the entirety of high school types in South Korea). The coefficient and the significance level in the <Table 1-10> follow a similar pattern to the results from <Table 1-9>, Even though the magnitude of the estimates is greater than those in the main analysis. This could be due to school effects, with the outliers being specialized schools and autonomous schools in South Korea, as they are considered to have higher-quality school conditions, including students with high academic scores, facilities, curriculum and staff, than general high schools. However, when the same empirical model applied to the only student in the specialized school in Appendix F, there was no significant impact of Wee Class on school adaptation except for Attitude 1 and 3 in Group1.

Secondly, <Table 1-11> reports the estimates using the 2011 cohort of the NAEA. And the lagged dependent variables of the main data; 2010 cohort is used for the additional robustness check. The effect of Wee Class using the 2011 cohort was only measured via 'Academic Achievement' due to the lack of dependent variables in the data. Column (1) reports the robust impact of Wee Class on Academic Achievement within Groups 1 and 3. In addition, the magnitude of the coefficient in Group3 was a twofold increase of the main result in <Table 1-9>.

Columns (2) and (3) utilize lagged dependent variables from the 2010 cohort that were used in the main analysis of this study. Equation (2) is used for this robustness check.

$$Y_{igt-1} = \alpha + \gamma After_t + \delta_1(G_1 \times A_t) + \delta_2(G_2 \times A_t) + \delta_3(G_3 \times A_t) + X'_{igt}\varphi + \rho_i + \varepsilon_{igt} \text{---- (2)}$$

If the impact of Wee Class on those lagged dependent variables (elementary school) displays a different direction of the main estimates in <Table 1-9>, smaller coefficient, and insignificant results compared to the main results of this study, the result of the main model can be considered robust. The estimates of Groups 1 and 3 in column (2) and (3) in <Table 1-11> all show a negative direction on the lagged dependent variable. Even though the estimates were significant in the conventional significance level, the direction of the estimates can explain the robust impact of Wee Class.

<Table 1-10> The Effect of Wee Class Intervention on School Adaptation (Full data)

Dependent Variable	Attitude towards Learning				Attitude School	Academic Achievement
	Attitude 1	Attitude 2	Attitude 3	Attitude 4		
	(1)	(2)	(3)	(4)	(5)	(6)
Group1 *After	0.050**	0.051***	0.043**	0.060***	0.017*	0.021***
	(0.015)	(0.015)	(0.017)	(0.017)	(0.007)	(0.005)
Group2 *After	0.015	0.024	0.011	0.046**	0.009	0.009+
	(0.015)	(0.015)	(0.016)	(0.016)	(0.007)	(0.005)
Group3 *After	0.052***	0.069***	0.039**	0.089***	0.021***	0.028***
	(0.014)	(0.013)	(0.015)	(0.015)	(0.006)	(0.004)
Control	Y	Y	Y	Y	Y	Y
FE	Y	Y	Y	Y	Y	Y
N	489,016	489,453	489,729	489,629	490,365	490,771
N(Id)	246,530	246,539	246,541	246,540	246,546	246,552
R-sq.	0.037	0.033	0.028	0.024	0.047	0.019

Note: Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01 ***p<0.001 This table reports the analysis using the whole high school sample (including all types of school; general school, science high school and foreign language school etc.). The details of control variable can be found in Appendix E.

<Table 1-11> Robustness Check

Data	2011 cohort	2010 cohort	
Dependent variable	Academic Achievement	Lagged Academic Achievement	Lagged Attitude towards School
	(1)	(2)	(3)
Group1*After	0.014*	-0.047***	-0.017*
	(0.007)	(0.006)	(0.009)
Group2*After	-0.012	0.001	0.007
	(0.007)	(0.006)	(0.008)
Group3*After	0.019**	-0.016**	-0.008
	(0.006)	(0.006)	(0.007)
N	570,278	427,171	425,908
N(id)	290,501	214,645	214,223
R-sq.	0.03	0.004	0.004

Note: The robustness check in the Column (1) is used by 2011 cohort. Column (2) and (3) are used lagged dependent variables for the dependent variable using 2010 cohort. Control variables and Fixed effects were all included. Robust standard errors are in parentheses. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001

B. Heterogeneous Effects

This part explores the effect of Wee Class using a subdivided dependent variable, since the main analysis used the sum of the relevant variables as a dependent variable. How the effects of Wee Class were affected by various school characteristics is also reported.

B.1.The Effect of Wee Class on the Subdivided Dependent Variables

First, <Table 1-12> reports the effect of Wee Class on Attitude towards Learning by each subject. The students in NAEA were initially asked to assess their Attitude towards Learning in each of the following subjects: Korean Language, English, and Math. However, the main analysis in <Table 1-9> used the aggregated value of Attitude towards Learning for all three subjects. Hence, <Table 1-12> attempted to check the value for each subject. The dependent variable in Panel A is Attitude towards Learning for Korean Language; Panel B contains the same variable for English, and Panel C for Math.

In the case of English in Panel B, the effect of Groups 1 and 3 was robust to the main results in <Table 1-9>. Furthermore, for Group2, attitude 4 in column (4) even had the statistical

significance. However, concerning the estimates for the remaining subjects, Korean and Math, the effect was ambiguous. In the case of Korean in Panel A, only Group3 was significant in Attitudes 1, 2, and 3. In Panel C for the subject Math, Group1 showed statistical significance, but only in Attitudes 1, 2, and 4, and within a 10 % significance level.

<Table 1-12>The Effect of Wee Class on Attitude towards Learning by Subjects

	Attitude 1	Attitude 2	Attitude 3	Attitude 4
	(1)	(2)	(3)	(4)
	Panel A. Attitude towards Learning for Korean Language			
Group1*After	0.006	0.009	0.006	-0.005
	(0.008)	(0.008)	(0.008)	(0.009)
Group2*After	0.002	0.006	0.007	0.010
	(0.008)	(0.008)	(0.008)	(0.008)
Group3*After	0.015*	0.023**	0.019**	0.011
	(0.007)	(0.007)	(0.007)	(0.008)
N	426,635	426,759	426,704	426,675
N(id)	214,642	214,641	214,639	214,638
R-sq.	0.019	0.018	0.024	0.011
	Panel B. Attitude towards Learning for English			
Group1*After	0.018*	0.023**	0.009	0.028**
	(0.008)	(0.008)	(0.009)	(0.009)
Group2*After	0.011	0.020*	0.004	0.020*
	(0.008)	(0.008)	(0.009)	(0.008)
Group3*After	0.017*	0.031***	0.011	0.040***
	(0.007)	(0.007)	(0.008)	(0.008)
N	426,430	426,686	426,658	426,615
N(id)	214,636	214,638	214,640	214,638
R-sq.	0.021	0.021	0.026	0.038
	Panel C. Attitude towards Learning for Math			
Group1*After	0.015+	0.015+	0.011	0.019+
	(0.008)	(0.008)	(0.009)	(0.010)
Group2*After	-0.012	-0.009	-0.016+	-0.000
	(0.008)	(0.008)	(0.009)	(0.010)
Group3*After	0.001	0.005	-0.009	0.016+
	(0.007)	(0.007)	(0.008)	(0.009)
N	426,476	426,424	426,764	426,741
N(id)	214,636	214,638	214,640	214,640
R-sq.	0.028	0.025	0.043	0.024

Note: The dependent variable; Attitude towards Learning is measured in terms of each subject Korean Language, English, and Math. The control variables and individual fixed effects were included in the model. Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01 ***p<0.001

Secondly, Academic Achievement for each subject is also considered as a dependent variable in <Table 1-13>. Columns (1) through (3) in Panel A used the main restricted data (limited to general high school), and columns (4) through (6) used the full data set including all other types of high school. In general high schools, the Wee Class intervention in middle school was shown to be effective within Group1, both in Korean and Math. In the case of English, however, the continuous intervention in Group3 was most effective. The whole high school sample in panel B, representing general high schools, followed a similar pattern.

<Table 1-13> The Effect of Wee Class on each Subject's Academic Scores

	Panel A. General High School			Panel B. Whole High School		
	(1)	(2)	(3)	(4)	(5)	(6)
	Korean	English	Math	Korean	English	Math
Group1*After	0.017*	0.002	0.020**	0.018**	0.009	0.031***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)
Group2*After	-0.005	-0.005	-0.006	0.005	0.012*	0.012+
	(0.007)	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)
Group3*After	-0.013*	0.026***	0.010	-0.004	0.047***	0.035***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)
After	0.029***	0.039***	0.034***	-0.005	-0.004	-0.014*
	(0.007)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)
Control	Y	Y	Y	Y	Y	Y
FE	Y	Y	Y	Y	Y	Y
_cons	-4.066***	-4.844***	-4.371***	-2.938***	-3.404***	-2.444***
	(0.133)	(0.124)	(0.145)	(0.120)	(0.109)	(0.127)
N	426,880	427,143	426,382	490,458	490,743	489,869
N(id)	214,639	214,643	214,636	214,546	246,550	246,543
R-sq.	0.009	0.015	0.013	0.007	0.011	0.008

Note: The standardized academic scores of each subject are used for dependent variable. Each subject is Korean Language, English and Math. Columns (1) through (3) are using samples only with general schools and columns (4) through (6) are based on the whole school sample including specialized schools. Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01 ***p<0.001

However, evidence from previous studies on academic achievement indicates that academic scores are highly variable, depending on school quality and ranking. Those effects are known as school effects or peer effects (Clark & Bono, 2016; Ellison & Swanson, 2016; Garlick, 2014; Damgaard & Nielsen, 2018). For this reason, <Table 1-14> attempted to determine the

heterogeneous effect of academic achievement by school effect. Thus, the data was divided into high-performing schools and low-performing schools, using both general school data and the full data set (representing all types of schools).

In <Table 1-14>, a school is considered 'high-performing' if it falls into the top 25% of the school mean of academic achievement among all other schools in the data. Conversely, a school is labelled as 'low-performing' if it falls in the bottom 25% of the schools in the data. All the estimates from each group follow the same pattern as the main results in <Table 1-9>. Notably, when groups are separated by the school level mean of academic scores, students in high-performing schools have a higher magnitude of estimates for each Group than those in low-performing schools. In addition, Group2 in high-performing schools also experienced a statistically significant positive effect, which could not be found in the main analysis. Even the magnitude of the coefficient of Group 2 in the high-performing school is the highest among the three groups: Group1, Group2 and Group3.

On the other hand, the effect of Wee Class on students' school adaptation in low-performing schools only has statistical significance in Group3. This result demonstrates that, students in low-performing schools were not significantly affected by only exposure to Wee Class in middle school, but experienced an increase in academic scores once they were continuously exposed to Wee Class from middle school to high school. This pattern can be found both in column (2) and (4).

<Table 1-14> The Effect of Wee Class by Average School Academic Scores

	Panel A. General High School		Panel B. Whole High School	
	(1)	(2)	(3)	(4)
	High performing School	Low performing School	High performing School	Low performing School
Group1*After	0.068***	0.009	0.037*	0.006
	(0.018)	(0.016)	(0.015)	(0.016)
Group2*After	0.085***	0.012	0.071***	0.011
	(0.018)	(0.016)	(0.015)	(0.016)
Group3*After	0.083***	0.044**	0.058***	0.048***
	(0.016)	(0.014)	(0.014)	(0.014)
N	96,394	112,515	121,499	122,586
N(id)	76,540	94,434	95,538	103,352
R-sq.	0.019	0.044	0.019	0.045

Note: The standardized total academic achievement is separately analyzed based on school abilities. The high performing school in the Column (1) and (3) are top 25% among high school (grouped by school mean of academic achievement). The low performing schools are bottom 25% in the same manner as the top 25%. Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01 ***p<0.001

B.2 The Effect of Wee Class by School Location

Another concern is that school location can often reflect the characteristics of the community. Schools in urban areas may have more access to information on mental health and other supportive resources for students, as well as better teaching quality. In addition, the experience and competence level of counselors in Wee Classes installed in schools in urban areas may also be different from those in schools in rural areas.

On the other hand, students in rural areas can be in higher need of these resources, and the government is more likely to provide financial support to students in rural areas as vulnerable students are larger in rural areas than urban areas (Truscott & Truscott, 2005). Such regional differences could cause inconsistencies in the estimates. For this reason, <Table 1-15> divided groups into three locations: big city, small and medium city, and rural area to determine if the location affects the results.

The estimates for the big city category in panel A follow a similar pattern to the main result

in <Table 1-9>. Moreover, the effects of Wee Class on Academic Achievement are demonstrably larger in the big city category compared to schools in other areas. One result that was particularly unusual showed that Wee Class intervention had a negative effect on Academic Achievement at schools in rural areas. On the other hand, in the case of Attitude towards school, the effect on students in the small and medium city and rural area categories was statistically significant and positive, while it was insignificant for the big city category. This result indicate that there might be a different targeting point of the Wee Class program between schools in the big city and rural area.

Since the schools in rural areas showed an unusual direction for academic achievement, this subsample was again divided into high-performing schools and low-performing schools using school averages of academic scores for a more detailed analysis. <Table 1-16> demonstrates these results: Panel A represents high-performing schools that make up the top 25% of school mean of academic scores among high schools in rural areas, and Panel B represents low-performing schools that fall in the bottom 25%. The statistically significant negative direction in the academic achievement in a rural area in column (6) in <Table 1-15> was disappeared in <Table 1-16>. Group2 in Panel B was still significantly negative in academic achievement though. Another noticeable result is the continuous intervention of Wee Class (Group3) was significantly positive in 'Attitude towards learning; Attitude 1,2, and 4' and 'Attitude towards school' in the low performing school while it was an insignificant or negative effect in the high performing school.

<Table 1-15> The Effect of Wee Class by School Location

	Attitude towards Learning				Attitude towards School	Academic Achievement
	Attitude 1	Attitude 2	Attitude 3	Attitude 4		
	(1)	(2)	(3)	(4)		
			Panel A. Big City			
Group1*After	0.107**	0.136***	0.104**	0.132***	0.008	0.086***
	(0.033)	(0.032)	(0.035)	(0.036)	(0.015)	(0.011)
Group2*After	-0.020	0.023	0.035	0.075*	0.015	0.034**
	(0.032)	(0.031)	(0.034)	(0.035)	(0.014)	(0.011)
Group3*After	0.048	0.084**	0.065*	0.116***	0.022	0.069***
	(0.029)	(0.029)	(0.031)	(0.032)	(0.013)	(0.010)
N	167,161	167,277	167,407	167,388	167,646	167,783
N(id)	86,498	86,570	86,513	86,513	86,523	86,530
R-sq.	0.037	0.035	0.028	0.023	0.051	0.044
			Panel B. Small and Medium City			
Group1*After	0.010	0.017	0.002	0.016	0.031**	0.019*
	(0.024)	(0.024)	(0.026)	(0.027)	(0.011)	(0.008)
Group2*After	0.036	0.032	-0.002	0.014	0.021*	0.009
	(0.024)	(0.023)	(0.026)	(0.026)	(0.011)	(0.007)
Group3*After	-0.012	0.016	-0.016	0.027	0.028**	0.020**
	(0.021)	(0.021)	(0.023)	(0.023)	(0.010)	(0.007)
N	201,248	201,441	201,563	201,522	201,832	201,994
N(id)	109,592	109,611	109,620	109,617	109,640	109,654
R-sq.	0.035	0.032	0.027	0.024	0.040	0.019
			Panel C. Rural Area			
Group1*After	0.024	-0.035	-0.045	-0.037	0.040+	-0.109***
	(0.048)	(0.047)	(0.051)	(0.053)	(0.022)	(0.015)
Group2*After	-0.126**	-0.111*	-0.188***	-0.103*	3.95e-02	-0.069***
	(0.045)	(0.044)	(0.049)	(0.049)	(2.18e-02)	(0.013)
Group3*After	0.096*	0.078+	0.055	0.072	0.044*	-0.108***
	(0.041)	(0.040)	(0.044)	(0.045)	(0.019)	(0.013)
N	57,184	57,250	57,274	57,256	57,342	57,394
N(id)	36,435	36,460	36,465	36,459	36,488	36,507
R-sq.	0.050	0.043	0.037	0.028	0.054	0.052

Note: Robust standard errors are in parentheses +p<0.10 *p<0.05 **p<0.01 ***p<0.001 All the regression in each panel included individual fixed effect and controls. Panel A is for the school location in the Big cities (Metropolitan cities), Panel B is small and medium city, and Panel C is for the schools in the rural area.

<Table 1-16> The Effect of Wee Class in Rural Area (by School Level Academic Score)

	(1)	(2)	(3)	(4)	(5)	(6)
	Attitude1	Attitude2	Attitude3	Attitude4	Attitude School	Academic Achievement
			Panel A. High Performing School			
Group1*After	-0.649	-1.537***	-0.217	-0.206	-0.144	-0.316
	(0.507)	(0.462)	(0.623)	(0.576)	(0.237)	(0.198)
Group2*After	-1.103**	-0.968*	-0.526	0.060	-0.405*	0.075
	(0.397)	(0.376)	(0.488)	(0.417)	(0.204)	(0.150)
Group3*After	-0.604	-0.452	0.052	0.257	-0.389*	-0.010
	(0.390)	(0.363)	(0.477)	(0.400)	(0.184)	(0.144)
N	6,276	6,286	6,285	6,283	6,284	6,289
N(id)	5,845	5,855	5,854	5,852	5,854	5,858
R-sq.	0.078	0.095	0.055	0.085	0.102	0.153
			Panel B. Low Performing School			
Group1*After	0.183+	0.124	-0.010	0.032	0.039	-0.004
	(0.098)	(0.097)	(0.110)	(0.117)	(0.048)	(0.030)
Group2*After	-0.158+	-0.172+	-0.269**	-0.059	0.040	-0.055*
	(0.093)	(0.092)	(0.102)	(0.107)	(0.042)	(0.028)
Group3*After	0.317***	0.279**	0.132	0.311**	0.101*	-0.023
	(0.093)	(0.094)	(0.103)	(0.108)	(0.042)	(0.028)
N	20,884	20,895	20,901	20,895	20,927	20,948
N(id)	16,522	16,530	16,533	16,528	16,540	16,553
R-sq.	0.057	0.049	0.051	0.035	0.060	0.057

Note: Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01 ***p<0.001 All the regression in each panel included individual fixed effect and controls. The schools in the rural area are sorted for the heterogeneity test in this table. Panel A is the top 25% among high school in the rural area (grouped by school mean of academic achievement). The low performing schools in Panel B are bottom 25% in the same manner as the top 25%.

B.3. The Effect of Wee Class by Gender

In most developed countries female students tend to have higher educational attainment than male students (David & Wasserman, 2013). However, Figlio, Karbownik, Roth and Wasserman (2016) confirm that male students, in fact, have better academic achievement than their female counterparts at the same school, once their schooling quality is high enough. On the other hand, female students show significant improvements in their academic achievement when the teacher quality, namely, teacher gender, is different (Lee, Rhee, & Rudolf, 2019). As

demonstrated by previous studies, students' gender can impact how they respond to differences in school quality. Thus, in order to analyze how students' reaction to Wee Class, an aspect of school quality, differed by gender, <Table 1-17> reports the effect of Wee Class according to student gender.

<Table 1-17> The Effect of Wee Class by Students' Gender

	Attitude towards Learning				Attitude towards School	Academic Achievement
	Attitude 1	Attitude 2	Attitude 3	Attitude 4		
	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A. Female			
Group1*After	0.062**	0.068**	0.032	0.050*	0.010	0.019**
	(0.021)	(0.021)	(0.023)	(0.023)	(0.010)	(0.007)
Group2*After	0.013	0.022	-0.023	0.010	0.003	-0.005
	(0.021)	(0.020)	(0.022)	(0.023)	(0.010)	(0.007)
Group3*After	0.045*	0.065***	-0.009	0.044*	0.004	0.003
	(0.019)	(0.018)	(0.020)	(0.021)	(0.009)	(0.006)
N	213,095	213,259	213,358	213,335	213,576	213,711
N(id)	107,326	107,332	107,333	107,330	107,333	107,334
R-sq.	0.030	0.028	0.023	0.018	0.035	0.014
			Panel B. Male			
Group1*After	0.011	0.013	0.014	0.031	0.020+	0.012
	(0.027)	(0.027)	(0.030)	(0.030)	(0.012)	(0.009)
Group2*After	-0.014	0.007	0.007	0.043	0.011	-0.010
	(0.026)	(0.025)	(0.028)	(0.029)	(0.011)	(0.008)
Group3*After	0.017	0.045+	0.040	0.080**	0.027*	0.010
	(0.024)	(0.023)	(0.026)	(0.026)	(0.011)	(0.007)
N	212,438	212,650	212,826	212,771	213,184	213,400
N(id)	107,267	107,270	107,272	107,273	107,277	107,281
R-sq.	0.044	0.040	0.035	0.030	0.059	0.042

Note: Robust standard errors are in parentheses +p<0.10 *p<0.05 **p<0.01 ***p<0.001 All the regression in each panel included individual fixed effect and controls. Panel A presents only female students. And Panel B is about only male students.

This analysis, once again, produced similar results on Wee Class impact to the main result in <Table 1-9>. However, as shown by relevant studies, female students' school adaptation was found to be stronger than that of male students, with the exception of Attitude 3 and Attitude towards School. Conversely, male students in Column (5) show a positive effect in Group1 and Group3.

1.5. Conclusion

1.5.1. Empirical results

This paper examined the impact of school counseling program on students' school adaptation in high school. Using the National Assessment Education Achievement (NAEA) collected in 2013 and 2015 from the entire student body in South Korea. This study implemented Difference-in-Differences with individual fixed effect to estimate the effect of exposure to Wee Class in different time periods. In order to remove any possible confounding effects of school type, this study restricted the data to students in general high schools. School-related controls were also included in the empirical model.

The results found that access to a school counseling service (Wee Class) in early adolescence could have a positive effect on students' school adaptation in their late adolescence. Even though the effect size in the main analysis was approximately 0.02 standard deviations, the positive impact of Wee Class on students in general high schools was robust and consistent when a different set of analyses was used. In addition, this paper estimated the effect of Wee Class when applied as a continuous intervention, from middle school to high school, and compared it to when Wee Class intervention began in high school. The results demonstrated that once students were exposed to a school environment with Wee Class continuously from middle school to high school, students' school adaptation was positively affected. However, intervention in students' late adolescence did not result in a significant impact on school adaptation.

Evidence that the effects of Wee Class on school adaptation can vary depending on school quality (based on the school mean of academic achievement), school location and student gender was found in the heterogonous analysis. In terms of Academic Achievement, the effect of Wee Class was strongest on high-performing school and on schools in urban areas. However, the Attitude towards School (I enjoy going to school) was significantly positive in both the

small and medium city and the rural area categories, while the effect on schools in urban areas was insignificant. Moreover, the effects of Wee Class were stronger on female students than on male students.

1.5.2. Interviews with School Counselors

In order to get school counselors' view on the empirical results in this study, the interviews with Wee Class counselors was conducted in the form of semi-structured interviews. Firstly, 20 school counselors were randomly selected from the official Wee Project websites. However, only 12 of them agreed to the interview when they were contacted. One counselor chose a face-to-face interview, two counselors chose a telephone interview, and the other nine counselors chose a written interview. In the case of the written interview, only 4 counselors were responded within the due dates. Therefore, there was a total 7 interviews done from June 11th to June 20th, 2019. Their opinion concerning the empirical results based on their experience and their policy expectations will be demonstrated here. Other information found during the interview is summarized in Appendix. A.3.

<Table 1-18> reports counselors' opinion on the empirical results. The findings from the empirical study are in Panel A, and counselors' views on the empirical results are in Panel B. School counselors generally agreed with the empirical results compared with their work experience. However, they added comments on the results. According to their comments, counseling programs do not generally have a direct effect, which requires long-term efforts not only in individual counseling but also in terms of the overall school atmosphere. For this reason, they emphasized that the earliest possible intervention is important. Counselors also expressed that students who have experienced Wee Class in their early school period tend to visit and participate in Wee Class programs more in their high school period. Moreover, the counselors lamented that most students find it difficult to participate in counseling programs when they enter high school, mostly due to a lack of time. In fact, counselors said that middle school

students participate in programs more, while high school students participate significantly less.

<Table 1-18> School Counselors' View about Empirical Results

	Panel A Empirical results	Panel B School counselors' view based on working experience
1	Early intervention (middle School) and Continuous intervention (from middle school to high school) are effective for students' high school adaptation	Students who have experienced Wee Class in middle school, and thus know how to use Wee Class well, freely come and visit Wee Class. Hence, the experience of Wee Class in middle school increases the participation in high school.
		Middle schools provide more diverse programs than high schools.
2	Later intervention (in high school only) was insignificant for students' school adaptation	High school students generally do not have enough time for group counseling, or visiting Wee Class due to their school classes (due to a test-based academic environment)
		Counseling is unlikely to produce a direct effect
		Perceptions of Wee Class differ - Middle school (exciting, free, diverse activity) - High school (meant for problematic students)
3	Heterogeneity effect: different effect between schools in urban and rural area.	There is a tendency that there are relatively more students who have a problematic background, with parents who are divorced, alcoholics, and/or are of low socioeconomic status in a rural area.
		Apart from the location, effective collaboration among schoolteachers head teachers, and resources from the community are important for the success of the program.
		Schools in rural areas have a larger program budget. Those schools get the budget through diverse routes.
		Schools in rural areas have fewer students and more teachers than schools in urban areas. This environment could help students' school adaptation.
	Heterogeneity effect (Female students experienced a greater effect on school adaptation than male students)	Female students respond better to counseling; male students get a better effect of school adaptation from their peer group.

This could be one of the reasons why the effect of Wee Class on school adaptation is insignificant for students whose first experience of the program was in high school. Lastly, counselors emphasized that the Wee Class programs can differ across schools and their quality

can depend on the competence levels of school counselors. For instance, in middle school, programs usually involve various personal and social activities, whereas in high school programs are centered on career development. Furthermore, schools in urban areas are more likely to deliver psychological programs, while the schools in rural areas focus more on providing social opportunities. However, they also added that rather than school characteristics, students' background (family, and community) are more likely to be different based on school location. The details are outlined in the <Table 1-18>.

1.5.3. Policy Implication

Based on the empirical results, it is plausible to suggest that government support and diverse program development for Wee Class are necessary at as early a stage of the educational process as possible. This study illustrated that Wee Class, as a non-cognitive intervention, when introduced in the early stages of school, could help students find their own individualized approach to learning, adjust to school life, and even improve their academic performance. Even though academically-focused education systems tend to underestimate the benefits of installing a counseling service at school, the measurable positive effects of Wee Class suggest that early intervention is indeed important.

In addition, from the school counselors' interview, this study collected the expecting changes for further improving Wee Class. All the expectations mentioned by counselors can be divided into 5 categories: government monitoring, facilities, school cooperation, personnel, and budget. <Table 1-19> below reports their expectations concerning Wee Class.

<Table 1-19> Policy Expectation about Wee Class from School Counselors

No	Policy Expectation about Wee Class from School Counselors	
1	Government Monitoring	Even though there is a manual for Wee Class, the authority of the school head teachers overrides that of Wee Class. Therefore, government-led monitoring programs for Wee Class should be conducted on a regular basis and backed up by school cooperation in order to support the counseling programs in the school.
2	Facilities	Some schools are using Wee Class as a meeting place for teachers or a resting lounge. A safe place that respects students' privacy necessary for effective counseling (including sound proofing, necessary facilities, and sufficient space for group counseling,)
3	School cooperation	Wee Class operation can be improved by bringing teachers and parents together to cooperate for the programs. Official programs that promote teachers' recognition of the importance of parents' involvement are necessary. When students wish to participate in Wee Class counseling, there is no officially recognized leave of absence. Instead, students generally use sick leave for going to Wee Class. As this may make students reluctant to use the service, school cooperation is necessary to allow students to use Wee Class freely.
4	Personnel	It is difficult to conduct counseling for all the students in a school by one counselor. Students in each grade may also have different targeting problems. Hence, one counselor per each school grade is highly recommended for better service quality and to prevent counselors' exhaustion.
5	Budget	Currently the official budget for the Wee Class is between 1 and 2million won. The official budget should, however, correspond to the number of students and school grades. In addition, Income differences between school counselors and general counselors doing the same work also remains a problem.

1.5.4. Limitation and Further Analysis

There are a number of limitations that should be considered when interpreting the findings of this study. Although students were allocated to high school randomly within a high school equalization admission system in most provinces, there were schools that did not use the random allocation system at the time of the survey. However, detailed information about both the school admission system and the province information from NAEA were not accessible. For this reason, even though this study used city size fixed effect and individual fixed effect, a

selection bias problem still remains. Secondly, although Wee Class aimed to target all students within a given school, there could be varying degrees of exposure among students in terms of the specific programs provided by Wee Class. However, this data did not provide the number of specific programs that students participated in. Moreover, the quality of counselor services could be one of the essential factors that can affect the quality of Wee Class programs. However, this information is also limited in the data.

For further analysis, firstly, considering the limitations of this study, more specific information about school location, the admission process of each school and a detailed description of Wee Class programs is needed. Secondly, given that the impact of Wee Class on school adaptation in late adolescence is largely driven by early intervention, the analysis of the impact of Wee Class needs to be conducted using elementary school information. Thirdly, it would be useful to test social adaptation outcomes in adulthood based on the effect of high school adaptation, which, in turn, was affected by early intervention in middle school. Finally, in most cases, either a single school counselor or a general counselor is responsible for Wee Class. Hence, their capability and effectiveness can be important for the success of the program. It would therefore be useful to conduct in-depth research for a more precise measurement of impact, by looking into counselors' skills, knowledge, technique, the number of programs and their quality.

Appendix A.1. Wee Class Annual Plan

Section	Contents	Period
Status Analysis	Students, Parents, School, Community Analysis	March, April
	Students at-risk analysis	The beginning of the semester
	Students, Parents, Teachers request survey	March
Counseling program construction / budget allocation	Facility, Personnel	March
	Webpages	Annual
	Networking service	March
	Budget allocation	February, March
Counseling	Individual counseling	Annual
	Group counseling	Annual
	Telephone, Cyber counseling	Annual
	Support for parents and teachers	Annual
Education	Peer counselor education	Annual
	Teacher training	Annual
	Parents counseling education	Annual
Psychological test	Individual test	Annual
	Group test	One-time
Training	Empowerment and training	Quarterly
	Supervision for empowerment	Annual
Administration work	Publication	Annual
	Case recording	Annual
	Evaluation	December
	Reports	December

Note: The proposed annual plan as an example in Wee Project Manual I is partly translated (Korea Education Development Institute, 2016, p20)

Appendix A.2. Wee Class Annual Plan

Contexts		Goal	Month											
			3	4	5	6	7	8	9	10	11	12	1	2
Individual counseling	Face to Face	Frequently	0	0	0	0	0	0	0	0	0	0	0	0
	Telephone, Cyber	Frequently	0	0	0	0	0	0	0	0	0	0	0	0
	Peer counseling	Annually			0	0	0			0	0	0		
	Mentoring (with teacher)	Annually			0	0	0	0	0	0	0	0		
	Mentoring (with parents)	Annually			0	0	0	0	0	0	0	0		
	Wee center & Professional agency	Frequently	0	0	0	0	0	0	0	0	0	0	0	0
Group counseling	Self-esteem promotion	4times	0	0					0	0				
	Sociality promotion	4times		0	0				0	0				
	Bullying	4times			0	0				0	0			
	Peer relation	4times				0	0				0	0		
	Career development	2times										0		0
	Learning method, understanding	2times										0	0	
	Mental training	3times			0	0	0							
Education	Peer counseling	Frequently	0	0	0	0	0	0	0	0	0	0	0	0
	Parents counseling academy	2times			0					0				
	Teacher counseling	2times			0					0				
Psychological test	Emotion and behavioral test	1time		0										
	Individual test	Frequently	0	0	0	0	0	0	0	0	0	0	0	0
	Teacher training	1time			0									

Note: The proposed annual plan as an example in Wee Project Manual I is partly translated (Korea Education Development Institute, 2016, p21)

Appendix A.3. Wee Class information captured by interviews with School counselors

1. Interview period: June 11th to 20th, 2019.

2. Participants: 7 school counselors

<Interview Participants>

No.	School	School type	School location	Gender
1	High school	Private	Big city	Female
2	High school	Private	Big city	Female
3	High school	Public	Small and medium city	Female
4	High school	Public	Small and medium city	Female
5	High school	Public	Small and medium city	Female
6	High school	Public	Rural area	Female
7	Middle school	Public	Small and medium city	Female

3. Interview Summary

Q: How would you define Wee Class?

A: Counselors defined Wee Class as the following: ‘a shelter’; ‘a place where students can rest their minds and bodies’; ‘a place where students can share any school anxieties’; one counselor used an analogy, describing Wee Class as lighthouse for students in the school. Most of the counselors interviewed emphasized that Wee Class makes students who experience difficulties, negative emotions and hostility regarding school, realize there is a safe space for them to express themselves.

Q: Who mostly visits Wee Class?

A: Officially, Wee Class is open to all students in the school. However, some students are more likely to seek Wee Class services than others. For instance, students who experience difficulties forming relationships with peers or feel alienated are more likely to visit Wee Class. On the other hand, there are also students who wish to discuss their career options, or share any problems they have with a neutral third party. This can also vary depending on the individual school’s culture and atmosphere. For example, while there are schools where students can

freely visit Wee Class for general communication with counselors at their own discretion, students need permission from homeroom teachers to visit Wee Class in other schools.

In some cases, general teachers do not allow students to visit Wee Class and school faculties do not cooperate with the school counselors. Hence, school counselors expressed that in order for Wee Class to be easily accessible for all students, cooperation from teachers and faculty staff is imperative.

Type		Students who visit Wee Class
1	Voluntary visits	Students who feel alienated Lack of family support (parental conflict, single parents) Students who want to share their problems Students who want to discuss their career path and future plans Most students (except for students who may be shy or extremely introverted)
2	Involuntary visits	Students involved in school violence When homeroom teachers find students with depression, lethargy, and school maladjustment, severe enough to affect their studies, they connect students to Wee Class.

Q: How would you define 'School adaptation'?

A: All the participants emphasized healthy relationships with friends and teachers, school satisfaction and effective stress management skills as aspects of sound school adaptation. When asked to choose which of the dependent variables in this empirical study can be best achieved through Wee Class, 7 counselors chose attitude towards school, and 3 counselors additionally selected attitude towards learning and academic achievement.

	Panel A. Empirical Study The definition of this empirical study	Panel B. School Counselor Interview Counselor's definition of school adaptation
1	Attitude towards Learning (I am interested in learning)	Finding individual goals and making an effort to achieve them
2	Attitude towards School (I enjoy going to school)	Quality relationships with peers and teachers Satisfaction with school life Stress management skills
3	Academic Achievement	Educational attainments

Q: What is the main role of Wee Class counselors?

A: The entire spectrum of roles carried out by counselors is summarized in the table below.

The categorized work in the table is in line with the Wee Class manual (shown in Appendices A.1 and A.2). Even though they followed the guidelines, counselors complained of overwork, pointing out that a single counselor is unable to effectively work with all the students in a school. Counselors also emphasized that unnecessary administrative work should be delegated, as it was taking up time that could be used for working with students.

No	Main programs	Details
1	Individual Counseling	Providing counseling for students with the school dropout crisis; students involved in school violence; follow-up counseling services; tour counseling for other schools; working with parents and teachers.
		Solving problems (career path, school adaptation, peer relations, academic anxiety, violence, school dropout preventive mentoring]
		Conducting individual therapeutic programs (using art, gardening etc.)
2	Group Counseling	Open-group counseling program for all students (monthly open group counseling, career path counseling (‘finding one’s dream’), helping students' write a bucket list, classroom-visiting counseling, etc.]
		Focusing on stress release, self-understanding self-expression, self-development, peer relations.
		Group Therapy programs
3	Program-based Services	Peer counseling support, extracurricular activities
4	Educational programs	Life-respecting and suicide prevention education, school violence prevention program
5	Psychological tests	Student Sentiment Behavior test, MBTI, TCI, MMP-A, SCT, HPT, surveys (happiness index, stress index)
	Campaign	Friendship strengthening week, career path week, counseling booth at school festivals, suicide prevention, counseling week, Wee Class-related publications
6	Administrative work	

Q: Do you think Wee Class changes the school atmosphere?

Participants	Answers
1	School counseling has become universally recognized in the school. Due to Wee Class, immediate intervention to prevent school maladaptation has become increasingly possible.
2	Teachers now admit that even when students come to Wee Class as a neutral, safe space where they can simply rest for a while, it impacts their school life positively.
3	Wee Class changes the school atmosphere by providing diverse programs regarding relationships. The biggest advantage of Wee Class being installed in schools is its effectiveness in terms of immediacy. For crisis teens, the point of intervention is important. Thus, its location on school grounds makes Wee Class directly accessible, which makes immediate intervention possible and increases pertaining to chances of success.
4	Teachers have become aware of the importance of counseling. Counselors share their knowledge with teachers; teachers, in turn, value and seek counselors' advice on managing students' behavior and the class atmosphere.
5	Teachers have begun looking at students' problematic behavior in a context of diversity, and discussing potential solutions with Wee Class workers. On the other hand, some teachers simply send students to Wee Class without cooperating with counselors or providing them with context.
6	Depending on school characteristics, teachers generally tend to support Wee Class programs. If the budget for Wee Class is sufficient, the programs and counseling will be promoted and provided to students more actively. Nevertheless, some schools continue to use Wee Class as a staff lounge.
7	Wee class gives students time to relax during difficult times, as well as providing counseling in a specially allocated room, making it a safe space where students can escape the tense school environment, especially during examination periods. Teachers can prevent problems by educating themselves on youth psychology, suicide prevention and school violence prevention, as well as by running classes with the help of counselors.

Appendix. B.1. Summary Statistics of Dependent Variables by Groups

	2013					2015				
	A11	G1	G2	G3	Control	A11	G1	G2	G3	Control
N	214,657	34,175	46,530	116,060	17,892	214,657	34,175	46,530	116,060	17,892
Attitude1	7.45	7.5	7.5	7.4	7.55	7.48	7.52	7.49	7.45	7.54
	(1.83)	(1.82)	(1.83)	(1.82)	(1.85)	(1.77)	(1.75)	(1.78)	(1.76)	(1.78)
Attitude2	7.48	7.54	7.52	7.43	7.58	7.54	7.59	7.55	7.52	7.59
	(1.8)	(1.8)	(1.8)	(1.8)	(1.82)	(1.74)	(1.73)	(1.76)	(1.74)	(1.75)
Attitude3	8.4	8.46	8.44	8.36	8.48	8.46	8.5	8.47	8.43	8.5
	(1.89)	(1.88)	(1.89)	(1.89)	(1.89)	(1.82)	(1.79)	(1.83)	(1.82)	(1.81)
Attitude4	8.55	8.62	8.6	8.49	8.64	8.63	8.67	8.66	8.6	8.66
	(1.9)	(1.88)	(1.9)	(1.9)	(1.89)	(1.78)	(1.76)	(1.79)	(1.79)	(1.77)
Attitude	2.85	2.87	2.87	2.83	2.87	2.86	2.86	2.88	2.85	2.86
school	(0.76)	(0.76)	(0.76)	(0.77)	(0.77)	(0.78)	(0.78)	(0.79)	(0.78)	(0.78)
Total	-0.08	-0.005	-0.09	-0.1	-0.03	-0.07	0.03	-0.11	-0.1	-0.02
academic	(0.96)	(0.95)	(0.98)	(0.95)	(1.00)	(0.95)	(0.95)	(0.99)	(0.92)	(1.00)
Korean	-0.06	0.01	-0.08	-0.07	-0.02	-0.05	0.05	-0.09	-0.08	-0.01
score	(0.98)	(0.97)	(0.99)	(0.97)	(1.00)	(0.96)	(0.96)	(0.99)	(0.93)	(0.99)
English	-0.08	-0.01	-0.07	-0.12	-0.01	-0.07	0.005	-0.09	-0.09	-0.01
score	(0.96)	(0.96)	(0.99)	(0.94)	(1.01)	(0.94)	(0.94)	(0.98)	(0.91)	(1.03)
Math	-0.08	-0.01	-0.09	-0.09	-0.04	-0.06	0.03	-0.1	-0.08	-0.03
score	(0.96)	(0.95)	(0.99)	(0.95)	(1.01)	(0.96)	(0.95)	(1.00)	(0.93)	(0.99)

Note: The standard deviations are in the parentheses.

Appendix. B.2. Summary Statistics of Dependent Variables (Elementary School)

	A11	G1	G2	G3	Control
N	213,859	34,077	46,359	115,599	17,824
Attitude School	3.11	3.13	3.11	3.1	3.12
	(0.76)	(0.75)	(0.76)	(0.76)	(0.75)
N	214,551	34,164	46,530	115,965	17,892
Academic Achievement	-0.08	-0.004	-0.09	-0.10	-0.029
	(0.96)	(0.95)	(0.98)	(0.95)	(1.00)

Appendix C.1. Validity Test regarding Students' Middle School Allocation

	Individual Characteristics	School Characteristics	Dependent Variables	All
	(1)	(2)	(3)	(4)
Female (=1, male=0)	0.001			0.002
	(0.011)			(0.011)
Parents (both parents =1)	0.001			0.004
	(0.005)			(0.004)
Private lesson (do not take any private lesson =1)	-0.002			-0.001
	(0.004)			(0.003)
Students number (6th grade)		5.40e-05		5.54e-05
		(1.76e-04)		(1.76e-04)
Teacher ratio		-0.003		-0.003
		(0.002)		(0.002)
Underprivileged students' ratio		0.030		0.031
		(0.053)		(0.053)
log average academic score		0.045		0.063
		(0.238)		(0.235)
Private school		-0.040		-0.039
		(0.054)		(0.054)
Small and medium city		-0.041		-0.041
		(0.024)		(0.024)
Rural area		-0.055*		-0.055*
		(0.028)		(0.028)
Dependent variable (Attitude towards School)			-0.004*	-0.005**
			(0.002)	(0.002)
Dependent variable (Academic Achievement)			-0.001	-0.002
			(0.003)	(0.001)
N	370308	370050	369313	368648
R-sq.	4.26e-06	0.003	5.10e-05	0.003

Note: Dependent variables in the columns (1) through (4) are Wee Class dummy (0,1) : whether there was Wee Class in the middle school or not. Column (1) considered only students characteristics during elementary school as independent variables, column (2) is for elementary school characteristics. Additionally, in column (3) the dependent variable in the main model of this study considered as independent variables. Lastly, all the variables from columns (1) through (3) are included together in column (4). Clustered standard errors by school are in the parentheses. *p<0.05, **p<0.01. Since the elementary school data do not provide 'total number of students of the school', the 'Students number' is calculated by the number of exam participation (6th grade). In terms of Dependent variable of the main analysis, elementary school data do not have 'Attitude towards Learning'. For this reason, I could only include 'Attitude towards School' and 'Academic Achievement'.

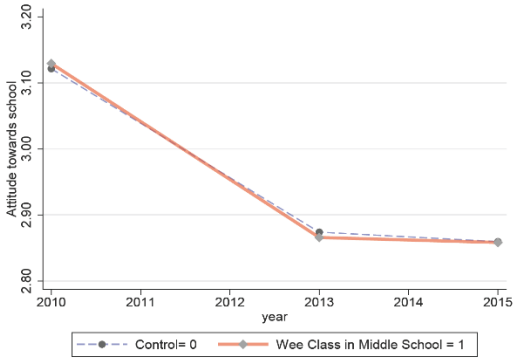
Appendix. C.2. Trend of Dependent Variable

There I no data about 'Attitude towards Learning' in the previous data set. For this reason, here, I only display the trend of dependent variable, 'Attitude towards School' and 'Academic Achievement'.

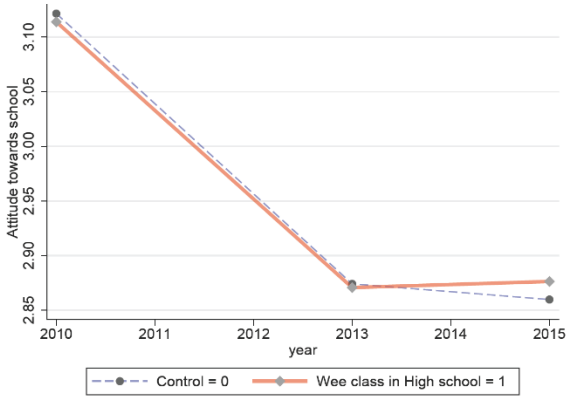
Panel A. Attitude towards School

Control Group vs. Group (1,2,3)

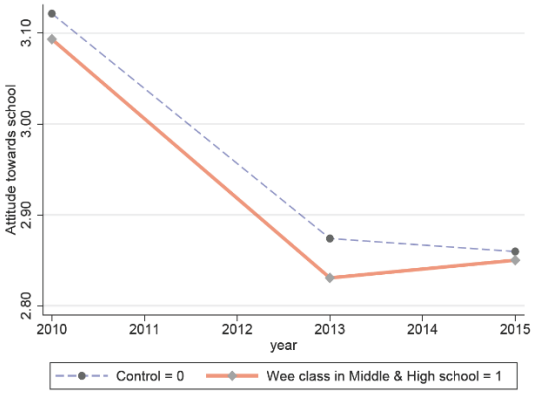
Control Group vs. Group1



Control Group vs. Group2

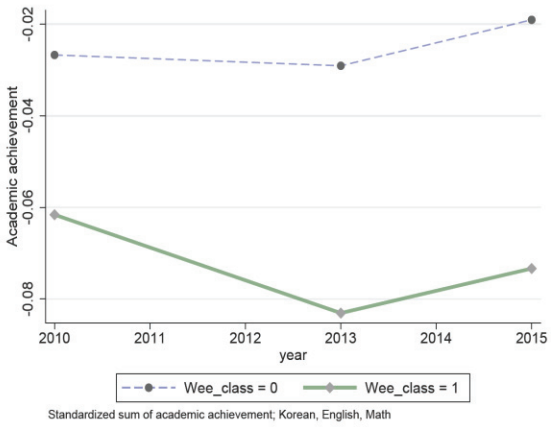


Control Group vs. Group3.

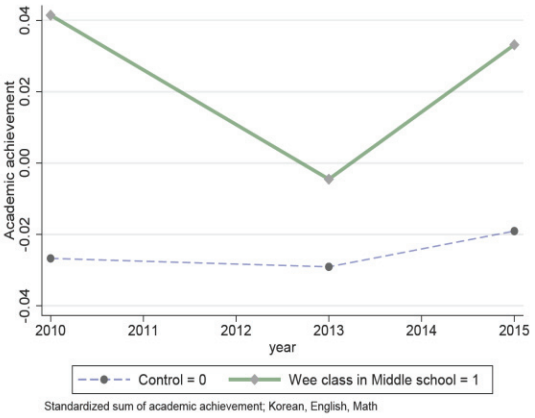


Panel B. Academic Achievement

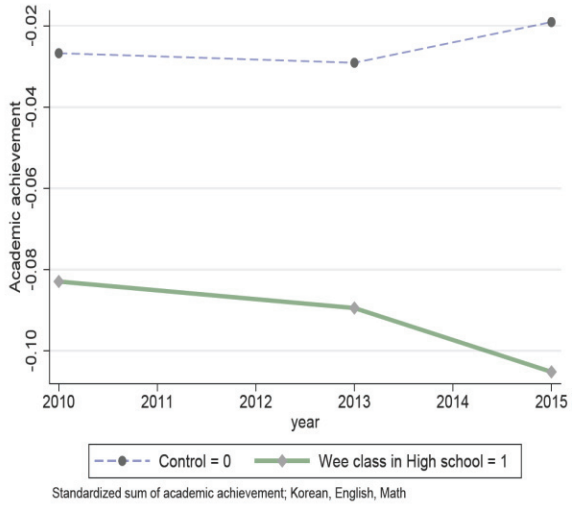
Control Group vs. Group (1,2,3)



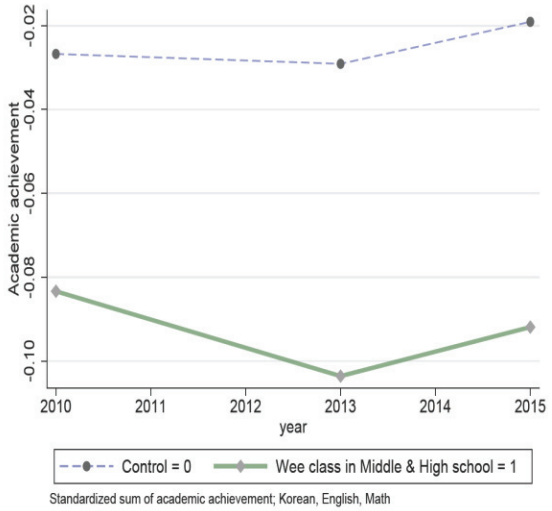
Control Group vs. Group1



Control Group vs. Group2



Control Group vs. Group3.



Appendix. D.1. Full Information of Table 1-9.

Dependent variable	Attitude towards Learning				Attitude School	Academic Achievement
	A1	A2	A3	A4		
	(1)	(2)	(3)	(4)	(5)	(6)
Group1*After	0.040*	0.045**	0.025	0.043*	0.015+	0.015**
	(0.017)	(0.017)	(0.019)	(0.019)	(0.008)	(0.005)
Group2*After	0.001	0.017	-0.005	0.029	0.009	-0.006
	(0.016)	(0.016)	(0.018)	(0.018)	(0.008)	(0.005)
Group3*After	0.033*	0.058***	0.021	0.067***	0.018**	0.009+
	(0.015)	(0.015)	(0.016)	(0.016)	(0.007)	(0.005)
After	0.049**	0.056***	0.076***	0.067***	0.015*	0.042***
	(0.016)	(0.015)	(0.017)	(0.017)	(0.007)	(0.005)
Parents	0.030*	0.022	0.071***	0.055**	0.036***	0.027***
	(0.015)	(0.015)	0.017	(0.017)	(0.007)	(0.005)
School Facilities	0.142***	0.133***	0.138***	0.129***	0.067***	0.005***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.002)	(0.001)
Extracurricular Activity	0.159***	0.144***	0.146***	0.129***	0.104***	0.006***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.002)	(0.001)
Decision Participation	0.122***	0.115***	0.113***	0.097***	0.065***	0.008***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.002)	(0.001)
PL: 1~2hrs/day	0.211***	0.191***	0.184***	0.179***	0.027***	0.044***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.004)	(0.003)
PL: 2~3hrs/day	0.249***	0.221***	0.244***	0.229***	0.030***	0.065***
	(0.009)	(0.009)	(0.010)	(0.010)	(0.004)	(0.003)
PL:More than 3hrs/day	0.333***	0.309***	0.324***	0.296***	0.041***	0.062***
	(0.010)	(0.010)	(0.011)	(0.011)	(0.005)	(0.003)
No. of students (log)	-0.128***	-0.126***	-0.099***	-0.104***	0.002	-0.024***
	(0.010)	(0.009)	(0.010)	(0.011)	(0.004)	(0.003)
Underprivileged student ratio	-0.011	0.004	-0.006	-0.021	-0.013*	0.004
	(0.014)	(0.014)	(0.015)	(0.015)	(0.006)	(0.005)
Teacher ratio	-8.09e-05	3.55e-04	0.001	0.004***	-9.83e-05	0.001*
	(8.38e-04)	(8.25e-04)	(0.001)	(0.001)	(3.89e-04)	(0.000)
Average academic score (log)	-0.130**	-0.224***	-0.406***	-0.411***	-0.056**	0.844***
	(0.047)	(0.047)	(0.052)	(0.052)	(0.022)	(0.017)
Number of Youth Activity	0.002	0.003+	0.001	0.002	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.000)
Small city	0.011	0.012	-0.011	0.005	-0.027*	0.013
	(0.028)	(0.028)	(0.031)	(0.031)	(0.013)	(0.010)
Rural area	0.057+	0.046	0.036	0.024	-0.043**	0.024*
	(0.030)	(0.029)	(0.032)	(0.033)	(0.014)	(0.010)
Male only school	0.111***	0.128***	0.107***	0.096***	-0.050***	0.024***
	(0.011)	(0.011)	(0.012)	(0.012)	(0.005)	(0.003)
Female only school	-0.002	0.017+	-0.041***	3.04e-04	-0.081***	-0.024***
	(0.009)	(0.009)	(0.010)	(1.01e-02)	(0.004)	(0.003)
Private school	0.008	0.010	0.019*	0.020*	-0.022***	0.047***
	(0.008)	(0.008)	(0.009)	(0.009)	(0.004)	(0.003)
_cons	7.786***	8.482***	10.361***	10.631***	2.561***	-5.480***
	(0.297)	(0.294)	(0.326)	(0.327)	(0.136)	(0.105)
N	425,593	425,968	426,244	426,166	426,820	427,171
N(id)	214,623	214,632	214,635	214,633	214,640	214,645
R-sq.	0.037	0.034	0.028	0.024	0.046	0.027

Note: This table is reporting the detail estimates of <Table 1-9>. Among control variables, PL is private lesson. Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01 ***p<0.001

Appendix D.2. The Effect of Wee Class on School Adaptation (Clustered by high school)

Dependent variable	Attitude towards Learning				Attitude	Academic
	A1	A2	A3	A4	School	Achievement
	(1)	(2)	(3)	(4)	(5)	(6)
Group1*After	0.040	0.045+	0.025	0.043+	0.015	0.015
	(0.026)	(0.024)	(0.024)	(0.024)	(0.010)	(0.014)
Group2*After	0.001	0.017	-0.005	0.029	0.009	-0.006
	(0.025)	(0.023)	(0.023)	(0.023)	(0.010)	(0.015)
Group3*After	0.033	0.058**	0.021	0.067**	0.018+	0.009
	(0.024)	(0.021)	(0.022)	(0.021)	(0.009)	(0.014)
After	0.049*	0.056*	0.076**	0.067**	0.015	0.042**
	(0.024)	(0.022)	(0.023)	(0.022)	(0.010)	(0.016)
parents	0.030+	0.022	0.071***	0.055**	0.036***	0.027***
	(0.016)	(0.015)	(0.017)	(0.017)	(0.007)	(0.005)
School Facilities	0.142***	0.133***	0.138***	0.129***	0.067***	0.005**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)	(0.002)
Extracurricular Act.	0.159***	0.144***	0.146***	0.129***	0.104***	0.006***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)	(0.002)
Decision Participation	0.122***	0.115***	0.113***	0.097***	0.065***	0.008***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)	(0.002)
PL: 1~2hrs/day	0.211***	0.191***	0.184***	0.179***	0.027***	0.044***
	(0.010)	(0.009)	(0.010)	(0.010)	(0.004)	(0.003)
PL: 2~3hrs/day	0.249***	0.221***	0.244***	0.229***	0.030***	0.065***
	(0.010)	(0.010)	(0.010)	(0.011)	(0.004)	(0.003)
PL: more than 3hrs/day	0.333***	0.309***	0.324***	0.296***	0.041***	0.062***
	(0.011)	(0.011)	(0.011)	(0.012)	(0.005)	(0.004)
No of students (log)	-0.128***	-0.126***	-0.099***	-0.104***	0.002	-0.024**
	(0.014)	(0.013)	(0.014)	(0.014)	(0.006)	(0.008)
Underprivileged students ratio	-0.011	0.004	-0.006	-0.021	-0.013	0.004
	(0.021)	(0.021)	(0.020)	(0.022)	(0.009)	(0.016)
Teacher ratio	-0.000	0.000	0.001	0.004**	-0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Average academic score (log)	-0.130	-0.224**	-0.406***	-0.411***	-0.056+	0.844***
	(0.081)	(0.076)	(0.076)	(0.077)	(0.029)	(0.069)
Number of Youth Activity	0.002	0.003	0.001	0.002	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Small city	0.011	0.012	-0.011	0.005	-0.027+	0.013
	(0.033)	(0.034)	(0.035)	(0.035)	(0.015)	(0.019)
Rural area	0.057	0.046	0.036	0.024	-0.043**	0.024
	(0.036)	(0.037)	(0.037)	(0.036)	(0.016)	(0.023)
Male only school	0.111***	0.128***	0.107***	0.096***	-0.050***	0.024*
	(0.018)	(0.018)	(0.018)	(0.017)	(0.007)	(0.011)
Female only school	-0.002	0.017	-0.041**	0.000	-0.081***	-0.024*
	(0.016)	(0.016)	(0.015)	(0.015)	(0.006)	(0.009)
Private school	0.008	0.010	0.019	0.020	-0.022***	0.047***
	(0.013)	(0.013)	(0.014)	(0.013)	(0.006)	(0.009)
_cons	7.786***	8.482***	10.361***	10.631***	2.561***	-5.480***
	(0.510)	(0.476)	(0.478)	(0.481)	(0.184)	(0.428)
N	425593	425968	426244	426166	426820	427171
R-sq.	0.037	0.034	0.028	0.024	0.046	0.027

Note: The main empirical model is replicated by using clustered by high school. Clustered standard errors are in the parentheses. +p<0.10 *p<0.05 **p<0.01

Appendix. E. Full Information of Table 1-10.

Dependent variable	Attitude towards Learning				Attitude towards School	Academic Achievement
	A1	A2	A3	A4		
	(1)	(2)	(3)	(4)	(5)	(6)
Group1*After	0.050**	0.051***	0.043**	0.060***	0.017*	0.021***
	(0.015)	(0.015)	(0.017)	(0.017)	(0.007)	(0.005)
Group2*After	0.015	0.024	0.011	0.046**	0.009	0.009+
	(0.015)	(0.015)	(0.016)	(0.016)	(0.007)	(0.005)
Group3*After	0.052***	0.069***	0.039**	0.089***	0.021***	0.028***
	(0.014)	(0.013)	(0.015)	(0.015)	(0.006)	(0.004)
After	0.008	0.021	0.030*	0.017	0.004	-0.002
	(0.014)	(0.014)	(0.015)	(0.015)	(0.006)	(0.005)
Parents	0.030*	0.024+	0.072***	0.054***	0.032***	0.026***
	(0.014)	(0.014)	(0.016)	(0.016)	(0.007)	(0.005)
School Facilities	0.141***	0.132***	0.136***	0.127***	0.068***	0.003*
	(0.004)	(0.004)	(0.005)	(0.005)	(0.002)	(0.001)
Extracurricular Activity	0.156***	0.140***	0.145***	0.129***	0.104***	0.005***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.002)	(0.001)
Decision Participation	0.124***	0.116***	0.113***	0.096***	0.065***	0.008***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)	(0.001)
PL:1~2hours/day	0.207***	0.186***	0.179***	0.177***	0.028***	0.042***
	(0.008)	(0.008)	(0.009)	(0.009)	(0.004)	(0.003)
PL:2~3hours/day	0.238***	0.212***	0.236***	0.227***	0.031***	0.062***
	(0.008)	(0.008)	(0.009)	(0.009)	(0.004)	(0.003)
PL: More than 3hrs/day	0.327***	0.303***	0.317***	0.293***	0.044***	0.058***
	(0.009)	(0.009)	(0.010)	(0.010)	(0.004)	(0.003)
No. of students	-0.104***	-0.098***	-0.080***	-0.083***	0.007+	0.007*
	(0.009)	(0.009)	(0.010)	(0.010)	(0.004)	(0.003)
Underprivileged students' ratio	-0.012	3.61e-04	-0.002	-0.020	-0.010+	0.006
	(0.013)	(1.29e-02)	(0.014)	(0.014)	(0.006)	(0.004)
Teacher ratio	0.001+	0.002*	0.002**	0.004***	1.18e-04	0.001***
	(0.001)	(0.001)	(0.001)	(0.001)	(3.63e-04)	(0.000)
Average academic score	-0.417***	-0.508***	-0.699***	-0.718***	-0.142***	0.584***
	(0.039)	(0.039)	(0.043)	(0.042)	(0.018)	(0.014)
Number of Youth Activity	0.002	0.003+	0.001	0.002	0.001	0.001+
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.000)
Small city	0.002	-0.002	-0.019	-0.002	-0.038***	0.015+
	(0.025)	(0.025)	(0.027)	(0.027)	(0.011)	(0.009)
Rural area	0.057*	0.041	0.046+	0.029	-0.050***	0.034***
	(0.026)	(0.025)	(0.028)	(0.028)	(0.012)	(0.009)
Male only school	0.111***	0.123***	0.107***	0.101***	-0.049***	0.039***
	(0.010)	(0.010)	(0.011)	(0.011)	(0.004)	(0.003)
Female only school	0.013	0.032***	-0.021*	0.025**	-0.073***	-0.001
	(0.009)	(0.009)	(0.009)	(0.009)	(0.004)	(0.003)
Private school	0.012	0.011	0.020*	0.015+	-0.020***	0.044***
	(0.008)	(0.008)	(0.008)	(1.82)	(0.004)	(0.003)
_cons	9.509***	10.183***	12.156***	12.518***	3.095***	-3.953***
	(0.252)	(0.249)	(0.273)	(0.273)	(0.115)	(0.091)
N	489,016	489,453	489,729	489,629	490,365	490,771
N(id)	246,530	246,539	246,541	246,540	246,546	246,552
R-sq.	0.037	0.033	0.028	0.024	0.047	0.019

Note: This table is reporting the detail estimates of <Table 1-10>. Among control variables, PL is private lesson. Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01 ***p<0.001

Appendix. F. The Effect of Wee Class Intervention on School Adaptation (Specialized high school)

	Attitude1	Attitude2	Attitude3	Attitude4	Attitude School	Academic Achievement
	(1)	(2)	(3)	(4)	(5)	(6)
Group1 *After	0.166*	0.077	0.146*	0.091	-0.037	-0.029
	(0.073)	(0.071)	(0.073)	(0.071)	(0.033)	(0.030)
Group2 *After	0.179+	0.048	-0.049	0.024	-0.099*	-0.007
	(0.104)	(0.101)	(0.106)	(0.104)	(0.047)	(0.044)
Group3 *After	0.138+	0.036	0.083	0.057	-0.042	0.034
	(0.080)	(0.077)	(0.077)	(0.076)	(0.035)	(0.032)
After	-0.076	-0.005	-0.344**	-0.267**	-0.072	-0.129**
	(0.105)	(0.102)	(0.109)	(0.102)	(0.049)	(0.047)
Control	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes
_cons	15.899***	17.328***	14.172***	11.997***	2.253*	0.234
	(2.108)	(2.011)	(2.177)	(2.047)	(1.001)	(0.914)
N	8878	8885	8888	8881	8896	8904
N(id)	4770	4770	4770	4770	4770	4770
R-sq.	0.058	0.052	0.058	0.058	0.064	0.091

Note: Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01 ***p<0.001 The sample is restricted to specialized school (foreign language school and science high school.

References

Angrist, J. D., & Pischke, J. S. (2008). *Mostly harmless econometrics: an empiricist's companion*. Princeton University Press.

Adeyemo, D. A. (2005). Parental involvement, interest in schooling and school environment as predictors of academic self-efficacy among fresh secondary school students in Oyo State, Nigeria. *Journal of Research in Educational Psychology, No 5-3*(1), 163-180.

Araujo, A., Gottlieb, D., & Moreira, H. (2007). A model of mixed signals with applications to counter signaling. *The RAND Journal of Economics*, *38*(4), 1020-1043.

Becker, G. S. (1994). *Human capital revisited. In Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education (3rd Edition)*. The University of Chicago Press.

Berger, N., & Archer, J. (2016). School socio-economic status and student socio-academic achievement goals in upper secondary contexts. *Social Psychology of Education*, *19*(1), 175-194.

Benson, P. L., Scales, P. C., Hamilton, S. F., & Sesma, A. (2006). Positive youth development: Theory, research, and applications. *Handbook of child psychology*.

Brid, K. A., Castleman, B. L., Goodman, J., & Lamberton, C. (2017). *Nudging at a national scale: Experimental evidence from a FAFSA completion campaign.* Ed Policy Works Working Paper Series No. 54.

Bronfenbrenner, U. (1979). *The ecology of human development*. Harvard University Press.

Choi, S. K., Kim, D. M., Oh, I. S., Shin, E. J., Kim, I. G., Lee, I. H., Lee, S. Y., & Choi, B. M. (2011). *A Study on Outcome Analysis of Wee Project and its Future Development Plan*. Korea Development Institute. CR, 33.

Clark, D., & Del Bono, E. (2016). The long-run effects of attending an elite school: Evidence from the United Kingdom. *American Economic Journal: Applied Economics*, *8*(1), 150-76.

Cohen, G. L., Garcia, J., Apfel, N., & Master, A. (2006). Reducing the racial achievement gap: A social-psychological intervention. *Science, 313*, 1307–1310.

Cohen, G. L., Garcia, J., Purdie-Vaughns, V., Apfel, N., & Brzustoski, P. (2009). Recursive processes in self-affirmation: Intervening to close the minority achievement gap. *Science*, *324*(5925), 400–403.

Conti, G., & Heckman, J. J. (2014). *Economics of child well-being*. Springer Netherlands.

David, A., & Wasserman, M. (2013). *Wayward sons: The emerging gender gap in labor markets and education*. Third Way Report.

Damgaard, M. T., & Nielsen, H. S. (2018). Nudging in education. *Economics of Education Review, 64*, 313-342.

Dee, T. S. (2015). Social identity and achievement gaps: evidence from an affirmation intervention.

Journal of Research on Educational Effectiveness, 8(2), 149–168.

Dobbie, W., & Fryer Jr, R. G. (2014). The impact of attending a school with high-achieving peers: Evidence from the New York City exam schools. *American Economic Journal: Applied Economics*, *6*(3), 58–75.

Ellison, G., & Swanson, A. (2016). Do schools matter for high math achievement? Evidence from the American mathematics competitions. *American Economic Review*, *106*(6), 1244–1277.

Figlio, D., Karbownik, K., Roth, J., & Wasserman, M. (2016). School quality and the gender gap in educational achievement. *American Economic Review*, *106*(5), 289-295.

Figueroa, L. L. (2016). *Spatial Modelling for Understanding the Correlation between School Facilities and Academic Performance in the Philippines*. Doctoral Dissertation: University of New South Wales Austria

Gamboa, L. F., Rodríguez Acosta, M., & García-Suaza, A. (2013). Differences in motivations and academic achievement. *Lecturas de Economía*, (78), 9–44.

Galassi, J. (2017). *Strengths-based school counseling: Promoting student development and achievement*. Routledge.

Garlick, R. (2014). *Academic peer effects with different group assignment rules: Residential tracking versus random assignment*. Mimeo, Duke.

Gehlbach, H., Brinkworth, M. E., King, A. M., Hsu, L. M., McIntyre, J., & Rogers, T. (2016). Creating birds of similar feathers: Leveraging similarity to improve teacher–student relationships and academic achievement. *Journal of Educational Psychology, 108*(3), 342–352.

Gigliotti, P., & Sorensen, L. C. (2018). Educational resources and student achievement: Evidence from the Save Harmless provision in New York State. *Economics of Education Review*, *66*, 167-182.

Griffin, K. W., Botvin, G. J., Scheier, L. M., Diaz, T., & Miller, N. L. (2000). Parenting practices as predictors of substance use, delinquency, and aggression among urban minority youth: moderating effects of family structure and gender. *Psychology of addictive behaviors*, *14*(2), 174-184.

Gershenson, S., & Langbein, L. (2015). The effect of primary school size on academic achievement. *Educational Evaluation and Policy Analysis*, *37*(1_suppl), 135S-155S.

Hanushek, E. A. (2016). What matters for student achievement. *Education Next*, *16*(2), 18-26.

Hansen, K. T., Heckman, J. J., & Mullen, K. J. (2004). The effect of schooling and ability on achievement test scores. *Journal of econometrics*, *121*(1-2), 39-98.

Hanushek, E. A. (1998). Conclusions and controversies about the effectiveness of school resources. *Economic Policy Review*, *4*(1), 11-27.

Hahn, Y., Wang, L. C., & Yang, H. S. (2018). Does greater school autonomy make a difference? Evidence from a randomized natural experiment in South Korea. *Journal of Public Economics*, *161*, 15-30.

Heckman, J. J., Humphries, J. E., & Veramendi, G. (2018). The Nonmarket Benefits of Education and

Ability. *Journal of Human Capital*, *12*(2), 282–304.

Heckman, J. J., Stixrud, J., & Urzua, S. (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor economics*, *24*(3), 411-482.

Hyun, Y. C. (2018). *A study on Seeking Institutionalization of Alternative Education in Korea: Analyze policy settings*. Doctoral Dissertation: Korea National University of Education.

Kim, J. N. (2015). Development and Validation of School Adjustment Scale for Middle School Student and High School Student. *The Korean Journal of Counseling and Psychotherapy, 25*(3), 497-517.

Kim, S. J., Kim, W. S., Park, I. Y., Seo, M. A., Han, J. A., Kim, M. H., Min, S. H., Lee, B. R., & Shon, J. N., (2016). *High school National Assessment of Educational Achievement Results, Korea Institute for Curriculum and Evaluation* (ORM 2016-32-2). Seoul: Korea Government Office Printing.

Kim, S. Y., Kim, J. E., (2014). The effect of Wee project. *The Korea Association for Policy Analysis and Evaluation. 24*, 115-133.

Kim, H. K., Kim, S. H., (2018). Effect of the School Ecological System Variables on Ninth Graders' Adjustment. *The Korea Journal of youth counseling*. *26*(1), 1-21.

Kim, H. J., Kim, Y. H., Kim, C. J., & Kim, M. H. (2013). *The Advanced Solution for Development of the General High schools in Korea.* Korea Education Development Institute (Publication no. OR 2013-05).

Kwak, S. R. (2006). A Structural Equation Modeling Analysis of Adolescents' School Adjustment. *History of education. 16*(1), 1-26.

Kwak, S. R. (2012). A causality analysis of the academic achievement, teacher's expectation and student's academic adjustment. *Korean Journal of Sociology of Education, 22*(1), 1-24.

Korea Education Development Institute (2011). *A study on the Wee project analysis and development planning.* (CR. 2011-32). Seoul: Korea

Korea Education Development Institute. (2015). *A Study on the Establishment of Job Standard and Evaluation System for the Wee Center Operation* (CR 2016-07). Seoul: Korea.

Korea Education Development Institute. (2016). *Wee Project Manual 1. Wee Class*. (CRM 2016-47). Seoul: Korea.

Korea Educational Statistics Service. (2018). Retrieved from https://cesi.kedi.re.kr.

Lee, S. J., Kim, S. H., & Kim, H. K., (2016). The Study on Factors Affecting the High School Students' Satisfaction. *The Journal of Welfare and Counseling Education*, *5*(2), 143-166.

Lee, J. H. (2017). An Analysis of Individual and School Characteristics affecting School Maladjustment of Middle School Students: Focusing on Middle Schools in Busan. *Korean Journal of Educational Administration*, *35*(5), 245-274.

Lee, J. Y. (2016). *Developmental Trajectories of Youth's Prosocial and Antisocial Behaviors, Focusing on the School Domain Predictor Variables*. Doctoral Dissertation: Graduate School of Ewha

Womans University.

Lee, J., Rhee, D. E., & Rudolf, R. (2019). Teacher Gender, Student Gender, and Primary School Achievement: Evidence from Ten Francophone African Countries. *The Journal of Development Studies*, *55*(4), 661-679.

Lee, K. M., & Kim, M. S. (2008). A Validation Study of School Adjustment Scale for Middle School Students. *The Korean Journal of School Psychology, 5*(1), 27-40.

Lee, K. M. (2005). A Study of Middle-School Students' School Adjustment Constructs. *The Korean Journal of Counseling and Psychotherapy, 17*(2). 383-398.

Leonard, T. C. (2008). Richard H. Thaler, Cass R. Sunstein, Nudge: Improving decisions about health, wealth, and happiness. *Constitutional Political Economy, 19*(4), 356-360.

Learner, D. G., & Kruger, L. J. (1997). Attachment, self-concept, and academic motivation in high-school students. *American Journal of Orthopsychiatry*, *67*(3), 485-492.

Lipscomb, S. (2007). Secondary school extracurricular involvement and academic achievement: A Fixed effects approach. *Economics of Education Review*, *26*(4), 463–472.

Lin-Siegler, X., Ahn, J. N., Chen, J., Fang, F. A., & Luna-Lucero, M. (2016). Even Einstein struggled: Effects of learning about great scientists struggles on high school students' motivation to learn science. *Journal of Educational Psychology, 108*(3), 314–328.

McMahon, H. G., Mason, E. C., Daluga-Guenther, N., & Ruiz, A. (2014). An ecological model of professional school counseling. *Journal of Counseling & Development*, *92*(4), 459-471.

Ministry of Education. (2016). *2015 Statistics of School Dropout Students*. Retrieved from http://www.moe.go.kr.

Midgley, C., & Feldlaufer, H. (1987). Students' and teachers' decision-making fit before and after the transition to junior high school. *The Journal of Early Adolescence*, *7*(2), 225-241.

Marchetti, R., Wilson, R. H., & Dunham, M. (2016). Academic achievement and extracurricular school activities of at-risk high school students. *Educational Research Quarterly*, *39*(4), 3.

Morash, M., & Moon, B. (2007). Gender differences in the effects of strain on the delinquency of South Korean youth. *Youth & Society*, *38*(3), 300-321.

OECD (2017). *PISA 2015 Results (Volume III): Students' Well-Being, PISA*, OECD Publishing, Paris. Retrieved from https://doi.org/10.1787/9789264273856-en.

Paik, S. J. (2013). *Role of private schools in Korea's educational development.* Knowledge Sharing Program: KSP Modularization.

Park, I. Y., Kim, W. S., Seo, M. H., Jung, H. K., Han, J. A., Lim, U. J., Kim, M. H., Jung, A. K., & Min, S. H. (2017). *2016 High school National Assessment of Educational Achievement Results, Korea Institute for Curriculum and Evaluation* (ORM 2017-43-2). Seoul: Korea Government Office Printing.

Park, J. H. (2013). Exploring the Structural Relation of the School Environment to School Adjustment. *The Journal of Yeolin Education*. *21*(1). 101-128.

Practical Law. (n.d.) High school Admission. Retrieved from http://easylaw.go.kr

Rodriguez-Planas, N. (2012). Longer-term impacts of mentoring, educational services, and learning incentives: Evidence from a randomized trial in the United States. *American Economic Journal: Applied Economics*, *4*(4), 121–139.

Sherman, D. K., Hartson, K. A., Binning, K. R., Purdie-Vaughns, V., Garcia, J., Taborsky-Barba, S., et al. (2013). Deflecting the trajectory and changing the narrative: How self-affirmation affects academic performance and motivation under identity threat. *Journal of Personality and Social Psychology, 104*(4), 591–618.

Spencer, M. B. (1999). Social and cultural influence on school adjustment: The application of an identity-focused cultural ecological perspective. *Educational psychologist, 34*, 43-57.

Sim, J. Y. (2017). *An Analysis on the Effects of Wee Class: Focusing on middle schools in Seoul.* MA: Seoul National University.

Sink, C.A. (2005). Contemporary school counseling. Boston, MA: Houghton Mifflin company.

Sohn, H. (2016). Mean and distributional impact of single-sex high schools on students' cognitive achievement, major choice, and test-taking behavior: Evidence from a random assignment policy in Seoul, Korea. *Economics of Education Review*, *52*, 155-175.

Suri, T., Boozer, M. A., Ranis, G., & Stewart, F. (2011). Paths to success: The relationship between human development and economic growth. *World Development*, *39*(4), 506-522.

Turner, H. A., Shattuck, A., Finkelhor, D., & Hamby, S. (2016). Polyvictimization and youth violence exposure across contexts. *Journal of Adolescent Health*, *58*(2), 208-214.

Tomul, E., & Savasci, H. S. (2012). Socioeconomic determinants of academic achievement. *Educational Assessment, Evaluation and Accountability, 24*(3), 175-187.

Tanner, B. (2017). Effects of Extracurricular Activities and Physical Activity on Academic Success. *INTUITION*, 158.

Thaler, R. H. & Sunstein, C.R. (2008). *Nudge improving decisions about health*, *wealth, and happiness*. Yale University Press.

Truscott, D. M., & Truscott, S. D. (2005). Differing circumstances, shared challenges: Finding common ground between urban and rural schools. *Phi Delta Kappan*, *87*(2), 123-130.

Yeager, D. S., Purdie-Vaughns, V., Garcia, J., Apfel, N., Brzutoski, P., Master, A., et al. (2014). Breaking the cycle of mistrust: Wise interventions to provide critical feedback across the racial divide. *Journal of Experimental Psychology: General, 143*(2), 804–824.

Enforcement Decree of the Elementary and Secondary Education Act. Act No. 29421. (2019).

Elementary and Secondary Education Act, Act no. 14603. (2017).

Chapter 2

Does Air Pollution Affect Teenagers' Subjective Well-being?

Abstract

This study explores the effect of air pollution on teenagers' subjective well-being in South Korea. Air pollution is one of the concerning factors that can worsen objective well-being, since air pollution levels in South Korea consistently exceed WHO guidelines. This may have a potentially negative effect on teenagers' subjective well-being despite living in a country where material well-being is relatively stable. By merging data from the Korea Child Youth Panel Survey (N=10,862, aged 13 to 19) with district-level air pollution data, this paper studied the effect of air pollution on teenager's subjective well-being, applying the Two-Stage Least Squares and Instrumental Variables (IV). This study found that air pollution increases 'negative affect' and reduces 'life satisfaction' in the context of children's subjective well-being.

2.1. Introduction

There is a growing interest in children's subjective well-being in a way of finding the effect of their disaggregated life dimension. Simultaneously subjective well-being has also been considered a product of children's objective well-being such as following tangible objective domains: material, health, education, behavior and housing (Bradshaw, Martorano, Natali, & de Neubourg, 2013; OECD, 2013b, 2015). The correlation between subjective well-being and objective well-being in the previous micro-level data analysis has shown a consistently strong and positive association. However, in more current international studies, living in a country with a high level of objective well-being does not seem to improve children's subjective well-being. According to the Organization for Economic Cooperation and Development (OECD), children in South Korea, in particular, showed low subjective well-being compared to other OECD countries, despite the objective well-being is relatively better (OECD, 2013a, 2014). Due to the ambiguity of these results, researchers have been trying to find other intangible factors that may explain the relationship between the losses in children's subjective well-being and children's comparatively good living conditions.

In psychology and sociology, cultural bias across nations and variation in personality traits on an individual level have been considered as the most relevant intangible factors affecting the variation in children's subjective well-being (Lee & Yoo, 2017; Veenhoven, 2012). However, from an economic perspective, the fact that air pollution is an intangible, anthropogenic factor, affecting teenagers' capabilities (e.g. health and cognition) in the current era, cannot be overlooked. Specifically, air pollution indirectly restricts children's ability to enjoy outdoor activities and, in severe cases, even it disturbs to attend school. Furthermore, poor air quality can indirectly worsen health conditions by reducing physical activity (Adams & Savahl, 2017; Currie, Hanushek, Kahn, Neidell, & Rivkin, 2009; Chen, Guo, & Huan, 2018; Evans, 2006). And it also directly cause health issues or worsen current illnesses, such as

asthma and other respiratory diseases. Burgeoning medical evidences have already demonstrated an increasing number of children's health problems caused by exposure to air pollution (Baek, Altindag, & Mocan, 2015; Esposito et al., 2014; Gauderman et al., 2015; Guarnieri & Balmes, 2014). Moreover, air pollution has been strongly linked to children's cognitive abilities and to lasting effects that continue throughout their life (Chen, Zhang, & Zhang, 2017; Clifford, Lang, Chen, Anstey, & Seaton, 2016; Midouhas, Kokosi, & Flouri, 2018).

From a traditional perspective on child well-being, the negative impact of air pollution on objective well-being could be assumed to worsen the level of subjective well-being. On the other hand, we can argue that improving air quality as a part of a life domain may mitigate the current discrepancy between objective and subjective well-being. However, air quality has been only considered as a causal effect of objective well-being and it has not been taken into the association between air quality and subjective well-being.

This paper endeavors to examine the importance of air quality in determining subjective well-being by using the Korea Children Youth Panel Survey (KCYPS). KCYPS is a nationally representative panel data set covering the period between 2010 and 2016. This study focuses on late childhood (hereafter teenagers), namely, the school period from 7^{th} grade through 12^{th} grade. However, due to the limitations of the data available on subjective well-being in the year 2011, only five years' worth of data was useable (2010, 2012, 2013, 2014, and 2015). Furthermore, this study excluded the year 2016 data, as the students had graduated high school by that time. Subjective well-being is analyzed jointly with data on particulate matter (PM_{10}) from Air Korea under the Ministry of Environment, merged by district code 230, provided by KCYPS. Since KCYPS was conducted October through December, air pollution data from the relevant period has been used for this analysis. However, since some districts lack an air-monitoring center, they are underrepresented in this data. To make up for this issue, the missing

data on air pollution has been matched with data from the most proximate air pollution-monitoring center using Arc GIS (Geographic Information System).

Due to the trans-boundary characteristics of air, the effect of air pollution on subjective well-being is difficult to measure and could easily be underestimated. Therefore, this study attempted to use data on wind direction during the survey period as an instrument for particulate matter (PM_{10}) in order to address the endogeneity problem (Baek et al., 2015; Jia & Ku, 2019). In order to use this methodology, meteorological data measured by the Automated Synoptic Observing System was merged with the district in KCYPS using Arc GIS via the same approach used above for air pollution data. Lastly, several regressions are performed to check the robustness of the results using particulate matter 2.5 ($PM_{2.5}$) and different time periods.

These results indicate that air pollution plays a statistically significant role in the variations in subjective well-being. It was also found that trans-border air circulation (wind direction) is important to consider when evaluating the effects of air pollution on subjective well-being.

The remainder of this paper is organized as follows: Section 2.2 contains literature reviews; Sections 2.3 through 2.5 describe the data, instrument variable, and methodology; Section 2.6 presents the results, robustness checks, and falsification test; Section 2.7 contains the limitations and the conclusion.

2.2. Literature

2.2.1. Ecological Systems

Bronfenbrenner's ecological systems theory (Bronfenbrenner, 1979) explained the role of children's immediate environment, listing four systemic definitions: 'microsystems,' 'mesosystems,' 'exosystems,' and 'macrosystems'. Microsystems include places like the home and school, where children can experience a certain pattern of roles, activities and interpersonal relationships. Mesosystem refers to the interrelation between the places where children are

actively participating, such as their school and neighborhood. Exosystems is the place where children are not involved in but still affect them, such as parents' workplace and the school class for older siblings. Lastly, macrosystem is a general form containing all the other three systems above within the context of cultural characteristics. For instance, schools and cafés exist in both France and the US, but those places would have different characteristics depending on the culture as a whole (Bronfenbrenner, 1979).

From the perspective of the ecological systems theory, children's development is achieved by interacting within each systemic environment, and children's subjective well-being can also be achieved by balancing with the surrounding environment. For this reason, it is important to consider the appropriate settings for children's environment and enrich the interactions within the environment. However, the components of children's surroundings constantly change depending on the time and period. It said that the environment itself can be highly vulnerable to children's development.

Nowadays, adverse changes in the natural environment can become an emerging environment for a human being. This can be included in the 'macrosystem' of the ecological systems theory (Bronfenbrenner, 1979), which means it is able to cover all the systems and disturb the role of each setting in children's development. For instance, natural disasters and environmental disruption can cause direct damage to children's physical health, which, along with damage to infrastructure, can interrupt their education; disasters can also have long-lasting psychological consequences, triggering conditions such as post-traumatic stress disorder, which can disturb children's daily life and development (Kousky, 2016). Such worsened environment conditions can lead to a deterioration in the structure of the entire social context, affecting children's safety, development, and happiness.

2.2.2. Air Pollution

Air pollution has recently emerged in our ecosystem, affecting our way of life and health. According to WHO, approximately two billion children in the world live in areas where pollution levels exceed WHO air pollution limits (20 microgram per cubic meter, PM_{10}) (Bradshaw et al., 2013; Rees, 2016; Adair-Rohani, 2018). Furthermore, it is estimated that seven million premature deaths occur in the world every year due to poor air conditions (Adair-Rohani, 2018). Empirical analysis of the direct effect of air pollution on health has shown that air pollution can increase morbidity rates, causing and aggravating respiratory conditions such as asthma, and negatively affecting the immune system (Baek et al., 2015; Esposito et al., 2014). Further research demonstrated that air pollution could lower children's cognitive abilities (Almond, Mazumder, & Ewijk, 2015; Clifford et al., 2016; Midouhas et al., 2018). Air pollution can also affect education indirectly by forcing children to reduce outdoor activities and even disturbing school attendance in severe cases (Adams & Savahl, 2017; Currie et al., 2009).

The harmful air pollution can be either emitted from the industrialized area, vehicle or transmitted by the wind when people do not recognize. Air pollutants can even form secondarily from mixtures of various contaminants in certain areas, via condensation or chemical reactions (Rees, 2016; WHO, 2006). The most familiar air pollutant mixture is a particulate matter that is an element that separates from gas in the air, which divided by their size, PM_{10} $(particle\ diameter \leq 10\mu g)$, $PM_{2.5}(particle\ diameter \leq 2.5\mu g)$ and an ultrafine fraction $(particle\ diameter \leq 0.1\mu g)$. It is generally known that the smaller size has a harmful effect on the human body.

<WHO/South Korea Guideline Levels for Particulate Matter>

Pollutants ($\mu g/m^3$)	PM_{10}		$PM_{2.5}$	
	Annual	24hours	Annual	24hours
WHO Guideline	20	50	10	25
South Korea	50	100	15	35

The South Korean government has been working on legal solutions reducing air pollution and helping preserve the environment in a sustainable manner since the 1990s (Clean Air Conservation Act, enacted in 1991). The government continues to actively focus on this issue, having recently enacted the Fine Dust Reduction and Management Act and enforcement decree (2019) and included provisions for the responsibilities of a master plan for every 5 years.

One of the representative government initiatives for mitigating the damage of air pollution is the air pollution alert system. This system works by sending alert messages to people's mobile devices if air pollution levels exceed the standards below, increasing awareness and allowing people to take precautions (Clean air conservation act, 2019; Fine dust reduction and management act, 2019).

Air pollution alert standards (Action plan for fine dust alert, 2019)

1. The average $PM_{2.5}$ of the day before (from midnight to 4p.m.) exceeds 50μg/m^3 and the following day is expected to exceed 50μg/m^3
2. Following the alert, if the next day is expected to exceed 50μg/m^3 of $PM_{2.5}$
3. The average of 24hours in $PM_{2.5}$ exceeds 75μg/m^3

During an air pollution alert or if air pollution exceeds 150 μg/m^3 per hour, schools (elementary, middle, and high schools) are encouraged to reduce school hours and limit outdoor classes (Enforcement Decree of Fin Dust Reduction and Management, 2019; Elementary and Secondary Education Act, 2017). In 2019, the government made the decision to install air purification facilities in every school from Jul 2, 2019 (School Health Act, 2019). The ministry of education also contributed to the effort by reducing asbestos in classrooms, setting a goal to eliminate it by 2027. These initiatives could help keep children healthy by minimizing their exposure to air pollution.

However, teachers in individual interviews voiced the concern that such policy keeps students trapped inside classrooms and forces them to reduce outdoor activities under the guise of protecting them from air pollution. Furthermore, children who were interviewed expressed that limiting outdoor activities could potentially lead to, or worsen, depressive states (personal communication, June 11th 2019, middle school and elementary school). Thus, even though top-down initiatives to mitigate the effects of air pollution may seem effective on paper, they could also have adverse side effects, restricting access to necessary resources and activities for children.

The advent of air pollution has changed the interaction of the ecological system surrounding children that have been used to explain the variation of children's subjective well-being (Yoo, 2016; Bradshaw, 2015).

2.2.3. Subjective Well-being

Subjective well-being has been a representative life evaluation both for adults and children in terms of their emotional status and their overall life satisfaction. Children's subjective well-being became a subject of research interest in the late 1980s via an international consensus, namely, The Convention on the Rights of the Child. At the time, young people's subjective well-being, as an object of research, was thought to be immeasurable and hence objective well-being markers such as parents' household income, parents' education, macroeconomic status indicators such as GDP, and children's health condition replaced for measuring subjective well-being. However, since the Stiglitz Commission and the OECD established the importance of subjective well-being for understanding children in 2009, an increasing number of countries have started to collect data on children (OECD, 2013b). Consequently, subjective well-being for children and adolescents has become the most commonly used measure of their life domain (Bradshaw et al., 2013).

Two main approaches to assessing subjective well-being can be identified in the literature. The first is using overall life evaluation (Ben-Arieh, 2008; Huebner & Dew, 1996; Pople, Rees, Main, & Bradshaw, 2015). The other approach is investigating subjective well-being through various questions and attempting to obtain accurate answers from children (Casas, 2017; Huebner, 1991). These approaches are based on the definition of three concepts; 'positive affect', 'negative affect' and 'global life satisfaction' (Diener, 1984; Diener, Scollon, & Lucas, 2003; Helliwell, Layard, & Sachs, 2012, 2015, 2016; Kim et al., 2006; Wang, 2015). The most representative measure of subjective well-being is the Students Life Satisfaction Scale (SLSS), which asks children to indicate the extent to which they agree or disagree with five nuanced statements related to subjective well-being, such as "my life is going well", "my life is just right", "I have a good life", "I have what I want in life", and "The things in my life are excellent" (Casas, 2017; Gilman & Huebner, 2003). However, this scale is generally used for young children who are less than 12 years old. For children in their late teens, overall life satisfaction is generally assessed using the statement, "How happy are you with your life as a whole?" (OECD, 2013b).

The variation in subjective well-being in the international studies has tried to compare the macro level objective well-being, such as GDP per capita, education, employment rates, youth employment, and inequality (Bradshaw et al., 2013). However, these variables had little association with children's subjective well-being (Bradshaw & Rees, 2017). Conversely, in the microdata, researchers constantly show diverse variation of subjective well-being using individual characteristics and the surrounding environment.

Children's subjective well-being generally tends to decrease as they get older (Youm, Kim, Sung, & Lee, 2018). The effects of gender are ambiguous and vary depending on situational factors and countries. Nevertheless, gender does play a role and thus should be taken into account. In South Korea, male children are generally more satisfied with life than female

children (Youm et al., 2018). Other factors affecting variations in children's subjective well-being cited in previous literature include family, school, community, socioeconomic status, and demographic status (Lee & Yoo, 2015; Sung & Kim, 2013). Both negative experiences such as bullying (Goswami, 2012; Savahl et al., 2019) and positive experiences such as social activities (Park & Wang, 2018) contribute to the variations in subjective well-being.

However, the most notable result in both the macro and micro level analysis is the lack of a linear relationship between subjective and material well-being, despite the expectation of a strong correlation between the two (Sarriera et al., 2015; Bradshaw & Rees, 2017; OECD, 2013a, 2014; Lee & Yoo, 2017). According to the annual report on Korean children and adolescents' happiness index, children in Korea have low levels of subjective well-being comparing to those of children in other OECD countries, despite having a relatively high level of objective well-being condition (Youm et al., 2018). In addition, reports on the role of material well-being in the micro data were ambiguous and even contradictory. On the one hand, Sarriera et al. (2015) found no association between material resources and children's subjective well-being in South Korea. On the other hand, using the same data from the International Survey of Children's Well-being project (ISCWeb), Yoo and Choi (2016) found that children's material deprivation index was correlated with children's subjective well-being, whereas the effect of the family income-to-need ratio was insignificant.

The studies of sociology about children's subjective well-being try to explain this discrepancy between material well-being and subjective well-being based on children's academic burden and the derived stress level in South Korea (Seo, 2016; Park, 2017). And as an intangible factors that naturally permeating people's lives, the tendency of collectivism existed in South Korea could show naturally lower subjective well-being comparing to individualism in other European countries (Lau, Cummins, & Mcpherson, 2005; Sarriera et al., 2015). Additionally, Lee and Yoo (2017) argue that a social environment where children have

freedom to choose and a positive view about themselves is the most critical factor that explains the variation between subjective well-being and objective well-being.

From an economic perspective, air pollution is mostly discussed as an intangible factor affecting children's objective well-being. According to previous studies on the effects of air pollution on young people, negative effects begin with prenatal exposure, and can have a lasting impact on children's health and intelligence long after birth (Almond et al., 2015; Baek et al., 2015). Baek et al. (2015), using birth record from over 1.5 million newborn babies between 2003 and 2011, found that 'yellow dust' from China and Mongolia can significantly increase the risk of complications such as low birth weight and premature birth. Esposito and his colleagues (2014) found that air pollution near roads was strongly correlated with incidences of both children's asthma and respiratory infections in children born to parents with a history of atopic disorders. A number of studies corroborate these findings, presenting evidence of the negative impact of air pollution on the cognitive abilities of children in their early teens (Cen, Lo, & Li, 2016; Chiu et al., 2016; van Kempen et al., 2012; Mohai, Kweon, Lee, & Ard, 2011).

Secondary effects of air pollution can also affect objective well-being. Namely, poor air quality forces children to limit outdoor activities, thereby limiting overall physical activity, which has numerous health benefits. Furthermore, air pollution can impact school attendance (Chen et al., 2018; Currie et al., 2009). Chen, Guo, and Huan (2018) demonstrated that the negative health effects of air pollution in particular had a measurable deleterious effect on children's school attendance. Similar studies on decreased school attendance due to air pollution have been done both in China and the US (Currie et al., 2009; Liu & Salvo, 2018). In the context of children's subjective well-being, however, the effect of spending time in nature on variations in subjective well-being was only discussed in qualitative research (Adams & Savahl, 2017; Kerret, Orkibi, & Ronen, 2014; Wells & Evans, 2003). Most studies on the association between subjective well-being and air pollution have been aimed at adults.

2.2.4. Air Pollution and Adult SWB

Previous studies on air pollution have either used the specific composition of pollutants, such as Particulate Matter(PM_{10}), Ozone(O_3), Sulfur dioxide(SO_2), Carbon monoxide (CO), and Nitrogen dioxide (NO_2) , or Air Pollution Information (e.g. Official alert data). Researchers aiming to assess the impact of pollution on physical and/or mental health tended to use the specific composition of pollutants, whereas those seeking to study the impact of air pollution on human behavior tended to use Air Pollution Information (API) data, measuring how people alter their behavior based on the expected air condition on a particular day.

Studies on subjective wellbeing in adults mostly used the physical or chemical composition of air pollution. However, recent papers from China have started to use API as a key variable for adult subjective well-being. Both air pollution and API were found to have a negative effect on the adults' subjective well-being (Brereton et al., 2008; Luechinger, 2010; Welsch, 2006; Yuan, Shin, & Managi, 2018; Zhang, Zhang, & Chen, 2017). Zhang and his colleagues (2017) found similar results by using a different measure of air pollution; $PM_{2.5}$ in their recent study in China. However, the effect of actual air conditions has not yet been discussed from the perspective of children's subjective well-being.

2.3. DATA

This paper endeavors to examine the importance of air quality on children's subjective well-being by using the Korea Children Youth Panel Survey (KCYPS). KCYPS was collected by the Korea National Youth Policy Institute from 2010 to 2016. The survey targets three cohorts: 1st grade, 4th grade, and 7th grade, all in the year 2010. Even though the age of individuals varied by two or three years in each cohort, the most common starting age in the first cohort was eight, in the second it was eleven, and in the third it was thirteen years old. The survey data is nationally representative, and uses multi-stage stratified sampling methods. The first survey was collected from October to November 2010. During regular school hours, the interviewers

visited each selected group of classes and helped students fill in the questionnaires. Subsequent surveys were conducted in the year 2011, and in every year thereafter until 2016 also from October to December. Parents' surveys were done by telephone each year excluding the baseline survey in 2010; in 2010, parents filled in the questionnaire, which students brought home from school.

This study focuses on teenagers in the middle school cohort (7^{th} grade cohort). Since the KCYPS used overall life satisfaction as a measure of subjective well-being, it used the middle school cohort based on the OECD guidelines, which stated that overall life satisfaction is statistically measurable after age 11 (OECD, 2013b). Traditionally, when assessing subjective well-being in early childhood, the approach has been to use multiple questions to obtain accurate estimates. However, the KCYPS did not use this approach for the elementary cohorts either.

The measures of subjective well-being in the KCYPS include overall life satisfaction, positive affect, and negative affect (Kim et al., 2006; Diener et al., 2003). The measurement was carried out using a self-reported four-point Likert scale: number one on the scale meant 'definitely yes', two meant 'probably yes', three was 'probably not', and four meant 'definitely not'. Each subjective well-being measure applied this scale to the following statements: for overall life satisfaction, "I think my life is happy"; for positive affect, "life is joyful to me"; for negative affect, "I do not have any worries". All answers, excluding those pertaining to negative affect, were reverse coded in this analysis. It follows that a higher score on overall life satisfaction and positive affect was labeled as positive and a higher score on the negative affect was stated to be negative.

The jointly used air pollution data in this analysis was sourced from Air Korea under the Ministry of Environment in South Korea. In cases where values about air pollution are missing, information from the nearest air-monitoring centre via Arc GIS was used instead. The original

data set provided air pollution information from 148 districts, and among the 230 districts that KCYPS provided, 82 were missing information. In addition, although the original data set accepted the values as statistically valid as long as they satisfied over 75% of the effective processing ratio, the data also provided pollution information between 50~75% of the effective processing ratio, which represents the number of times the air pollution data from each of the monitoring centres was collected during one of the following measuring periods: five minutes, one hour, and 24 hours (Air Korea, 2016). Thus, if the values between 50% and 75% were available, the information were used for this study instead of matching with data from proximate air-monitoring centers. A detailed illustration of the effective processing ratio of air pollution can be found in Appendix A. Since PM_{10} refers to the mixed form of air pollution which people are most familiar with in daily life, this study primarily focused on PM_{10} ($\mu g/m^3$) for measuring teenagers' subjective well-being.

The remaining data used for the instrument is taken from meteorological information measured by the Automated Synoptic Observing System (ASOS). KCYPS data was merged with this meteorological data using the 230 district code. When a district was missing in the meteorological dataset, it was represented using proximate information obtained via the same method used for missing air pollution data. However, seven districts happened to have two ASOS, resulting in two available sets of data. In these cases, the mean value of the two centers' data was used to represent that district. Those areas are Suncheon, Changwon, Chuncheon, Gangneung, Gochang, Jindo, and Jeju. After organizing the weather data, the proximate meteorological information found by GIS replaced the missing information. Figures in Appendix B illustrate the location of air pollution monitoring centers and automated synoptic observing systems in detail. <Table 2-1> describes the summary statistics.

<Table 2-1> Summary Statistics

Variable	Descriptive	Obs.	Mean	Std. Dev.	Min	Max
Panel A. Dependent variable						
Life Satisfaction	I think my life is happy	10,862	2.98	0.74	1	4
Positive Affect	I enjoy living my life	10,862	3.06	0.70	1	4
Negative Affect	I don't have anything worry about	10,862	2.53	0.86	1	4
Depression	Sum of depression index	6,423	19.15	5.81	10	40
Panel B. Air Pollution and Wind direction						
PM_{10}	Mean of PM10 (Sept.-Dec.)	10,521	43.76	8.26	21	77.25
$PM_{2.5}$	Mean of PM10 (Sept.-Dec.)	1,404	25.37	5.54	15	46
W	High wind direction(SW-NW)	11,755	0.05	0.21	0	1
S	High wind direction(SE-SW)	11,755	0.44	0.50	0	1
N	High wind direction(NW-NE)	11,755	0.38	0.48	0	1
E	High wind direction(NE-SE)	11,755	0.04	0.20	0	1
Panel C. Control variables						
Female	1 Yes/ 0 No	10,865	0.49	0.50	0	1
Age	Age	11,012	15.62	1.76	12	19
Bullying	No of bullying experience per year	11,755	0.57	8.67	0	302
Boys school	1 Yes/ 0 No	11,755	0.16	0.37	0	1
Girls school	1 Yes/ 0 No	11,755	0.18	0.38	0	1
Coedu_school	1 Yes/ 0 No	11,755	0.58	0.49	0	1
Peer relation	Sum of perceived peer relation	10,750	15.45	1.95	5	20
Study environment	Sum of perceived study environment	10,755	13.72	2.57	5	20
Com environment	Sum of perceived community	10,847	15.00	3.03	6	24
Log income	log(inc+1)	10,328	8.27	0.66	0	10.60
Mother education	Mother final education(4year college)	11,755	0.26	0.44	0	1
Parents'LS	Parent's life satisfaction	10,673	2.93	0.55	1	4
ln_rain	log(mean precipitation (mm))	10,650	4.38	0.35	3.75	5.23
Wind_speed	Mean wind speed (m/s)	10,650	2.15	0.85	0.9	4.86
Surface_ap	Mean surface air pressure (hPa)	10,650	1,010.47	5.32	927.3	1019.6

Note: PM_{10} in Panel B is key explanatory variable in this study. $PM_{2.5}$ is only one year data in the year 2015. The house type is not reported in the summary statistics; most children live in apartments (60%). Other housing types are detached house, row house, multiplex house, flat, and others.

2.4. Instrument Variable for Air Pollution

There are several concerns about the endogeneity problem of air pollution. First, environmental inequalities, such as a tendency for teenagers of low socioeconomic status to live in certain areas that happen to be more polluted (Hajat, Hsia, & O'Neill, 2015; Adair-Rohani, 2018; Gariepy, Elgar, Sentenac, & Barrington-Leigh, 2017). Given that, there could be reverse causality between subjective well-being and air pollution.

More importantly than this reverse causality problem, there may be other omitted determinants of subjective well-being that will be also correlated with air pollution. Finally, measurement errors can occur when determining levels of air pollution. Air pollution could be naturally more severe in a specific area due to a higher degree of urbanization, with a high proportion of cars and industrial complexes (Degraeuwe et al., 2017; Marino, Nucara, Pietrafesa, & Pudano, 2016; Emetere, Akinyemi, & Uno, 2015). Moreover, this study used a four month average value of air pollution data, since the main children's data set does not provide the specific interview dates and times, and only provides the period during which the survey was conducted. Thus, this data severely restricts the variation of air pollution.

Due to these limitations, attenuation bias can happen for measuring the effect of air pollution on subjective well-being. In this case, an instrument that can explain the variation of air pollution, but does not have a direct effect on subjective well-being, must be considered. For this reason, this study suggests that wind dynamics during the survey period can be a plausible instrument.

Air spreads and moves according to the wind direction in a regional area (Challinor, Adger, & Benton, 2017; Lemke et al., 2014; Oita et al., 2016). Where the wind blows from can have a significant effect on the air condition in a region. Jia and Ku (2019) demonstrate that the wind can cause exchange of air between South Korea and nearby newly industrialized countries. Also, Baek et al. (2015) suggested that direction of the wind relative to South Korea (north and

west) has been considered as the leading cause of air dust.

Also, previous studies do take into account the seriousness of trans-boundary air pollution on subjective well-being in specific regional areas (Challinor, Adger, & Benton, 2017; Lemke et al., 2014; Luechinger, 2010; Oita et al., 2016). Luechinger (2010) discussed the effect of trans-boundary pollution, using SO_2 from other countries to an instrument for nationally produced SO_2 in the analysis of individual data from Eurobarometer, and found a significant association with adults' subjective well-being. When he used the instrument, estimates of air pollution on subjective well-being became double that of the original OLS estimates.

2.5. Methodology

The subjective well-being is estimated by Two-Stage Least Square; equations (1) and (2)

$$\text{First stage: } P_{ds} = \alpha_0 + \mathrm{Z}'_{ids} + X'_{ids}\gamma + W'_{ids}\delta + \rho_h + \eta_d + \lambda_t + \omega_{ids} \ldots (1)$$

$$\text{Second stage: } SWB_{ids} = \alpha_1 + \beta P_{ds} + X'_{ids}\gamma + W'_{ids}\delta + \rho_h + \eta_d + \lambda_t + \varepsilon_{ids} \ldots (2)$$

In equation (2), 'second stage', the dependent variable SWB_{ids} represents the individual $i's$ self-reported subjective well-being (Kim et al., 2006), including life satisfaction, positive affect, and negative affect, in the residential district d during the survey period s. The key variable P_{ds} is the average PM_{10} in the district d at the survey period s. This study controls for a vector of relevant factors X'_{ids}relating to subjective well-being, including age, gender, school type, friendship, a number of bullying experiences, perceived school and community environment, and family status such as a log of household income, mother education, parents' subjective well-being, and housing type. The weather vector of W'_{ids} is also controlled for, in order to help mitigate the concern that weather conditions are correlated with both child subjective well-being and air pollution. ρ_h Indicates house type fixed effect; η_d represents district size

(myeon<eup<dong) fixed effect; λ_t indicates year fixed effect and ε is an error term.

Since air spreads and moves according to the wind direction in a regional area (Challinor, Adger, & Benton, 2017; Lemke et al., 2014; Oita et al., 2016), the wind from the north and west relative to South Korea has been considered as the main cause of Asian dust, which can change the concentration of air pollution in South Korea. In addition, the wind can cause an exchange of air between South Korea and nearby newly industrialized countries (Jia & Ku, 2019). Notably, the dominant wind direction, from highly polluted areas towards some districts in South Korea, will significantly affect pollution levels. The vector of wind direction Z'_{ds} was introduced as an instrument for PM_{10} in the first stage; in equation (1). The vector Z'_{ds} involves 4 direction dummies, divided to from 16 points compass marks (NNE 22.5, NE 45, ENE 67.5, E 90, ESE 112.5, SE 135, SSE 157.5, S 180, SSW 202.5, SW 225, WSW 247.5, W 270, WNW 292.5, NW 315, NNW 337.5, and N 360). N is north, E is east, S is south, and W is west. The 4 direction dummies are as follows: the first dummy is between NE and SE (hereafter E); the second is between SE and SW (S); the third is between SW and NW (W), and the last one is between NW and NE (N). Previous literature describes the severity of yellow dust from W and N of South Korea (Baek et al., 2015). For this reason, the analysis includes the direction towards the continent (N, W, and S) and uses E as a reference group.

2.6. Results

2.6.1. The Effect of Air Pollution on Teenagers' Subjective Well-being

<Table 2-2> reports the Two-Stage Least Squares (2SLS) estimates of variations in air pollution (particulate matter 10) on subjective well-being. Panel A presents the second stage of two-stage least squares and panel B is the first stage. Panel C reports the OLS estimates to compare the coefficient with the coefficient from panel A.

Columns (1) through (3) use the main dependent variable, subjective well-being, as

measured by three aspects: life satisfaction, positive affect, and negative affect. Column (4) measures depression as an additional dependent variable to mirror previous studies concerning air pollution.

The key variable is the mean of air pollution levels from September to December, which includes the survey period (October to December) and September. The inclusion of lagged air pollution in September is crucial since teenagers had been naturally exposed to air pollution in the same residential region just before the survey started, and the lagged air pollution may thus affects their subjective well-being.

The estimates of air pollution are statistically significant for both life satisfaction in column (1) and negative affect in column (3). When PM_{10}increased by 10 ($\mu g/m^3$) from the mean value, life satisfaction significantly decreased by 0.23 standard deviations (0.017 units), and negative affect increased by 0.33 standard deviations (0.028 units). However, the positive affect in column (2) was statistically insignificant within the increasing level of air pollution.

Panel B reports the instruments for air pollution as the impact of wind direction on air pollution in the first stage of 2SLS. Previously, Baek et al. (2015), and Jia and Ku (2019) indicated that yellow dust and the winds from the north of South Korea have severely exacerbated air pollution in South Korea. The result in panel B shows the same pattern as the previous studies. Moreover, the trans-boundary, transnational nature of air quality has been an all-time concern when considering the severity of air pollution in China specifically (Baek et al., 2015; Luechinger, 2010; Jia & Ku, 2019). Therefore, in this study, the wind direction dummies were used as an exogenous variable for air pollution (particulate matter 10): East, West, South, and North. Here, the East side was the reference group. The result demonstrated that all the wind direction (W, S, and N) comparing to the wind from the East severely increased air pollution level in Korea.

The validity tests of instruments are also strongly supportive of this model: both the F-

statistic and the under-identification test show the wind directions are fully correlated with air pollution by rejecting the null hypothesis that the equation is under-identified. In addition, the wind direction itself is one variable, so even if the wind direction is distinguished in four directions, it may be considered one variable and Hansen J statistics may not be needed. However, in this study, each wind direction is considered one independent variable. Hence, the over-identification test is conducted by Hansen J statistics for the validity of wind direction as instruments. The Hansen J statistic indicates, that there is no over-identification problem by demonstrating that the result cannot reject the joint null hypothesis that the instruments are valid instruments. In absolute terms, the 2SLS estimates of air pollution in panel A are approximately 5 to 9 times larger than the result from OLS in panel C.

There were also several noteworthy effects on the control variables, which are outlined in Appendix C. According to Appendix C. teenagers in co-ed schools were found to be more likely to be satisfied with their life than those in single-gender schools. Moreover, as confirmed by Lampropoulou (2018), social relationships, namely those with peers, teachers, and the general community are positively correlated with subjective well-being. The level of self-reported parents' life satisfaction was also positively correlated with teenagers' subjective well-being.

<Table 2-2> The Effect of Air Pollution on Subjective Well-being

Panel A. Second Stage				
	(1)	(2)	(3)	(4)
Dependent variable	Life Satisfaction	Positive	Negative	Depression
PM_{10} (μg/m^3)	-0.017**	-0.008	0.028***	0.133+
	(0.006)	(0.006)	(0.008)	(0.069)
Control/ Weather	Y	Y	Y	Y
House type FE	Y	Y	Y	Y
District FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
_cons	-1.368	-0.128	2.402	45.280***
	(1.520)	(1.353)	(1.726)	(13.524)
N	9,911	9,911	9,911	8,089
R-sq.	0.133	0.149	0.065	0.142
Panel B. First Stage (Dependent variable: PM_{10} (μg/m^3))				
Excluded IV	(1)	(2)	(3)	(4)
W	4.666***	4.628***	4.665***	4.665***
	(0.290)	(0.322)	(0.290)	(0.290)
S	4.925***	4.261***	4.927***	4.927***
	(0.291)	(0.327)	(0.291)	(0.291)
N	7.217***	5.862***	7.222***	7.222***
	(0.481)	(0.424)	(0.481)	(0.481)
Included instrument	Y	Y	Y	Y
_cons	3.341	3.341	3.341	48.532**
	(13.385)	(13.385)	(13.385)	(16.086)
N	9,911	9,911	9,911	8089
F-test(p-value)	112.78(0.00)	112.78(0.00)	112.78(0.00)	80.3(0.00)
Under identification (p-value)	244.01(0.00)	243.83(0.00)	244.01(0.00)	167.9(0.00)
Hansen J statistic (p-value)	0.69(0.71)	0.56(0.76)	1.85(0.39)	3.08(0.21)
Panel C. OLS				
	(1)	(2)	(3)	(4)
PM_{10} (μg/m^3)	-0.003*	-0.001	0.003*	0.017
	(0.001)	(0.001)	(0.001)	(0.011)

Note: Subjective well-being consists of three measures: 'life satisfaction', 'positive affect', and 'negative affect'. Depression in column (4) is additionally included for measuring the effect of air pollution on mental health conditions. Panel A. presents the second stage of 2SLS. Panel B presents the first stage. And panel C reports the estimates of OLS. The detailed estimates of other controls of <Table 2-2> can be found in Appendix C. and D. The regression used individual fixed effect is in Appendix K. Robust standard errors are in parentheses. * p<0.05, **p<0.01, ***p<0.001

Additionally, in order to measure mental health in a similar way to previous studies that illustrated the negative effect of air pollution on cognitive abilities among children and mental health in adults (Clifford et al., 2016; Zhang et al., 2017). The standardized depression questions in Symptom Checklist 90-Revised (SCL-90-R) (Kim, Kim, & Won, 1984) is used as a dependent variable in Column (4). This checklist was originally designed to evaluate psychological problems and symptoms, targeting people aged thirteen or older. The original number of questions was thirteen, but the KCYPS chose the ten questions deemed most relevant to young people in South Korea. These questions consist of repeated statements such as 'I want to die', 'I do not need to be here' among others. For the dependent variable, depression, an aggregate score of ten questions is used. According to the result in column (4), the increase in air pollution by 10 ($\mu g/m^3$) was associated with the increase in depression increased by 0.22 standard deviations.

These effects become more pronounced if there are vulnerable adolescents in areas with bad air quality, such as adolescents who report suffering from asthmatic or atopic disorders. In this data, in the years 2010 and 2013, individuals reported whether they have any specific disorders, namely, asthma, rhinitis, atopy, heart disease, diabetes, or obesity. <Table 2-3> shows the effect of air pollution divided by health condition.

Panel A represents teenagers who reported suffering from any of the above diseases at the time of survey, while panel B does not take diseases into account. Both groups in panel A and B had the same direction of the effect on subjective well-being: life satisfaction and positive affect were negative, and negative affect in columns (3) and (6) was positive. However, the magnitude of the estimates was bigger for the teenagers in panel A compared to the results in <Table 2-2>, and the statistical significance disappeared for the teenagers who did not report suffering from any diseases in Panel B. The estimates in column (1) of panel A indicate that when the particulate matter increases by 10 ($\mu g/m^3$) on average, the level of life satisfaction

will decrease by one third of a standard deviation if the children were suffering from a disease. The negative affect in Coolum (3) also increased by a third of a standard deviation.

<Table 2-3> The Effect of Air Pollution on Subjective Well-being by Health Condition

Group	Panel A. Reported Disease			Panel B. No Disease		
Dependent Variable	(1) LS	(2) Positive	(3) Negative	(4) LS	(5) Positive	(6) Negative
PM_{10} (μg/m^3)	-0.024*	-0.001	0.029*	-0.009	-0.008	0.001
	(0.012)	(0.011)	(0.015)	(0.012)	(0.011)	(0.014)
Control	Y	Y	Y	Y	Y	Y
Weather condition	Y	Y	Y	Y	Y	Y
House type FE	Y	Y	Y	Y	Y	Y
District FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
_cons	-0.776	-1.973	2.933	-2.100	-2.485	4.995
	(4.377)	(3.915)	(4.676)	(3.467)	(3.234)	(3.744)
N	1,919	1,919	1,919	2,099	2,099	2,099
R-sq.	0.132	0.187	0.095	0.158	0.160	0.096
F-test(p-value)	31.6(0.00)	31.6(0.00)	31.6(0.00)	47.1(0.00)	47.1(0.00)	47.1(0.00)
Under id. (p-value)	72.3(0.00)	72.3(0.00)	72.3(0.00)	71.3(0.00)	71.3(0.00)	71.3(0.00)
Hansen J (p-value)	3.03(0.00)	2.40(0.30)	0.74(0.69)	3.14(0.21)	2.25(0.32)	1.39(0.50)

Note: Panel A and B are the groups divided by health condition, i.e. whether they reported any of the following diseases: Asthma, Rhinitis, Atopy, Heat disease, and others. The first stage is used wind direction for the excluded IV, particulate matter. The F-test, Underidentification test and Hansen J statistics demonstrates the validity of IV. The data including health condition was only the year 2010 and 2013. Robust standard errors are in parentheses. * p<0.05, **p<0.01, ***p<0.001

2.6.2. Further Analysis

A. Robustness Check

Since particulate matter size and the lagged effect of environmental conditions in teenagers' residential areas have been areas of concern within this model, alternative measures of air pollution were used as specification checks.

<Table 2-4> Alternative Measures of Air Pollution

Dependent variable	(1) Life Satisfaction	(2) Negative	(3) Positive
Panel A. Second Stage: Annual mean ; PM_{10} ($\mu g/m^3$)			
Annual mean ; PM_{10} ($\mu g/m^3$)	-0.014*	0.023**	-0.008
	(0.006)	(0.007)	(0.005)
N	9,911	9,911	9,911
R-sq.	0.141	0.079	0.149
Panel B. Second Stage: log PM_{10} ($\mu g/m^3$)			
log PM_{10} ($\mu g/m^3$)	-0.717**	1.172***	-0.356
	(0.264)	(0.329)	(0.248)
N	9,911	9,911	9,911
R-sq.	0.134	0.067	0.148
Panel C. Second Stage: Annual mean $PM_{2.5}$ ($\mu g/m^3$)			
Annual mean $PM_{2.5}$ ($\mu g/m^3$)	-0.018	0.036**	-0.006
	(0.011)	(0.012)	(0.010)
N	1,156	1,156	1,156
R-sq.	0.166	0.134	0.190
Panel D. Second Stage: log $PM_{2.5}$ ($\mu g/m^3$)			
log $PM_{2.5}$ ($\mu g/m^3$)	-0.347	0.772***	-0.124
	(0.230)	(0.221)	(0.204)
N	1,320	1,320	1,320
R-sq.	0.153	0.115	0.176

Note: This table replicating the main model with alternative measures of air pollution. Panels A through D used different types of measure of particulate matter. The air pollution used in Panel C and D is $PM_{2.5}$. However, the $PM_{2.5}$ was only available for one year in the year 2015. The first stage and the detailed controls of each panel can be found in Appendix E, F, G, and H. All the validity of the excluded instrument is valid through F-test, Underidentification test, and Hansen J statistics. Each panel included controls, housing type fixed, district size fixed, and year fixed. Robust standard errors are in parentheses. * p<0.05, **p<0.01, ***p<0.001

<Table 2-4> confirms that the main results are robust with regard to annual means of both regular particulate matter and smaller-sized particulate matter. The analysis in panel A uses the annual mean of PM_{10}. In panel C, as the value of particulate matter gets smaller, the annual mean of $PM_{2.5}$ is used. Panels B and D use the log form of $PM_{2.5}$ and PM_{10} measured during

the survey period.

Panel A shows that using the annual mean of air pollution results in a similar pattern to the main analysis in <Table 2-2>. Even though the magnitude of absolute term estimates is slightly reduced on life satisfaction and negative affect, this result indicates that high levels of PM_{10}, in both the general air condition during one year and the current period (September to December), can affect the level of children's subjective well-being. This analysis also found significance in the remaining panels. In panel C, the annual mean of $PM_{2.5}$ had an even stronger impact on negative affect compared to the estimates in <Table 2-2>, which demonstrates the smaller particulate matter is the more severe effect it will have for subjective well-being. But $PM_{2.5}$ was insignificant for life satisfaction.

<Table 2-5> The Effect of Air Pollution on Subjective Well-being (OLS vs. Probit)

Dependent variable	Panel A. OLS			Panel B. Probit (marginal effect)		
	LS	Negative	Positive	LS	Negative	Positive
	(1)	(2)	(3)	(1)	(2)	(3)
PM_{10} ($\mu g/m^3$)	-0.003*	0.003*	-0.001	-0.0014*	0.002*	0.0004
	(0.001)	(0.001)	(0.001)	0.0007	0.001	0.0006
Controls	Y	Y	Y	Y	Y	Y
House FE	Y	Y	Y	Y	Y	Y
District FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
N	9,911	9,911	9,911	9,911	9,911	9,911

Note: Panel A used OLS model and Panel B is the marginal effect of Probit model. The dependent variable is binary variable of subjective well-being; LS (life satisfaction), Negative affect, and Positive affect. Robust standard errors are in parentheses. * p<0.05, **p<0.01, ***p<0.001

Another concern is that the dependent variable, subjective well-being, is originally measured on a four-point ordered scale: one and two represent 'definitely not' and 'probably not' respectively, and three and four are 'probably yes' and 'definitely yes' respectively. The response could be expressed again as binary variable; 0 is 'not satisfied' and 1 is 'satisfied'. The concern about this dependent variable is that linear regression can be inappropriate to measure this dependent variable and a nonlinear model such as 'probit' is preferred. However, Angrist and Evan (1996) have already shown the estimates of the effect on limited dependent variables

using OLS, probit and its marginal effect, in their study about the effect of childbearing on mother's employment status. The results from both the linear and nonlinear models were almost identical (Angrist & Evan, 1996; Angrist & Pischke, 2008). In addition, Ferrer-i-Carbonell and Frijters (2004) have demonstrated that assuming ordinarily or cardinality of SWB makes little difference.

In order to demonstrate this view with this study, <Table 2-5> reports both OLS estimates and the marginal effect of Probit estimation. As following the previous discussions, the estimate size was similar and the significance on life satisfaction and negative affect was robust.

B. Falsification Test

<Table 2-6> Falsification Test (Random Distribution of Air Pollution)

Panel A. Second Stage			
	(1) LS	(2) Negative	(3) Positive
PM_{10} (μg/m^3)	0.032	0.032	-0.104
	(0.340)	(0.384)	(0.377)
Control/Weather	Y	Y	Y
House type FE	Y	Y	Y
District FE	Y	Y	Y
Year FE	Y	Y	Y
_cons	1.848	0.321	5.514
	(5.518)	(6.422)	(7.616)
N	1,244	1,244	1,244
R-sq.	0.087	0.086	-0.806
Panel B. First Stage (Dependent variable: pm10)			
W	-0.114	-0.114	-0.621
	(0.977)	(0.977)	(0.977)
S	0.090	0.907	0.113
	(0.984)	(0.984)	(0.983)
N	-0.165	-0.165	-.0.124
	(1.399)	(1.34)	(1.399)
Included instrument	Y	Y	Y
F-test(p-value)	0.03(0.99)	0.03(0.99)	0.04(0.98)
Under identification(p-value)	0.081(0.99)	0.08(0.99)	0.134(0.98)
Hansen J (p-value)	2.88(0.23)	4.02(0.13)	4.22(0.12)

Note: The sample were randomly selected and the air pollution were distributed to the sample randomly. Robust standard errors are in parentheses. * p<0.05, **p<0.01, ***p<0.001

<Table 2-6> shows the result from the falsification test. It is clear that if the worsened air pollution is falsely matched with children with higher subjective well-being, the effect of air pollution should be insignificant or show a positive sign. Then the test can show the main result is robust. Hence this study distributed air pollution randomly into randomly chosen samples for the falsification test. <Table 2-6> presents that the 2SLS estimates from randomly matched air pollution are insignificant for all components of children's subjective well-being. These results support the strong association between air pollution and children's subjective well-being in the main result in <Table 2-2>.

C. Validity of Instruments

The validity of using wind direction is threatened if another omitted variable affecting subjective well-being is potentially correlated with wind direction. In other words, the wind should be a source of exogenous variation in air quality, and it should not depend on individual teenagers' characteristics or background captured by the error term in the second stage. Hence, in order to check the validity of this instrument, this study attempted to control for several variables potentially associated with polluted wind direction and subjective well-being in Appendix I.

The additional control variables are 'the number of cars registered in 230 districts', 'the number of factories in 17 provinces', 'other individual characteristics, such as the number of diseases that young people suffer from', and their 'body mass index (BMI)', since those variables are considered as confounding factors for both air pollution and subjective well-being (Baek, 2016; Degraeuwe et al., 2017; Marino et al., 2016; Emetere, Akinyemi, & Uno, 2015). For instance, while car emissions in urban areas and factories in certain regions can cause air pollution, urban and economically activating areas could give more opportunities for teenagers to move freely or participate in diverse activities, which can increase their subjective well-

being. Additionally, since health condition is highly correlated with subjective well-being, diseases and BMI are both considered as additional control variables. However, when I included all those variables in the main equation, those variables did not overturn the main results in <Table 2-2> (as seen in column (2) and (3) of Appendix I.)

Another concern is that wind direction can affect subjective well-being through other weather condition. To account for this, this study has tried to see whether the wind direction as an instrument for the amount of rain, mean of surface air pressure, and wind speed during the survey period in Appendix I (column (4) and (5)). However, when those weather conditions were considered excluded IV, there was an over-identification problem through this channel and those channels turned out to be insignificant. Lastly, this study included the wind direction as an exogenous variable (Appendix I, column (6)), but a direct effect of wind direction on subjective well-being was not detected. From this evidence, it can be concluded that the trans-boundary air characteristic using wind direction can be plausible as an instrument for air pollution.

In addition, alternative weather instruments for air pollution were considered as IVs in Appendix J. The rainfall, air pressure or air pressure and mean of wind speed were not all valid as IVs. The rain was technically valid within the F-test but the rain was also strongly correlated with subjective well-being. In case of air pressure, the F statistics were less than 10 which cannot fully explain against week instrument. Lastly, both air pressure and wind speed were valid as IV itself through F-test and Hansen J statistics but air pollution was insignificant on subjective well-being.

2.7. Conclusion

This paper reported the effect of air pollution on teenagers' subjective well-being in South Korea. By merging KCYPS with air pollution and meteorological data, the estimates were

measured by 2SLS by using wind direction as an instrument for air pollution.

The major finding is a significant effect of air pollution; PM_{10} on teenagers' subjective well-being (Life satisfaction and negative affect), similar to the results of previous studies on adults' subjective well-being. More specifically, when PM_{10} levels increased by 10 micrograms per cubic meter, life satisfaction significantly decreased (0.23 SDs), and negative affect increased (0.33 SDs). However, the impact on positive affect did not have statistical significance. Depression, as an additional dependent variable, also increased as air conditions worsened. In addition, the results were robust with regard to different empirical models and alternative measures of air pollution, namely annual means of PM_{10} and $PM_{2.5}$.

These effects become more pronounced when estimates of air pollution were measured among vulnerable teenage populations with current health disorders. The level of subjective well-being of teenagers who reported suffering from diseases such as asthma, rhinitis, atopic conditions, and others, were more likely to be affected by air pollution than those who were not suffering from these disorders.

The findings suggest that air pollution as an intangible life domain, can affect children's subjective well-being by interacting with other confounding factors in ecological systems. However, a few limitations should be considered when we interpret the findings of this study. Although this study tried to match air pollution data by district code (230) and used the instrument for air pollution, concerns about underestimating the effect of air pollution remain, since each individual's specific residential area (such as their post code) could not be recognized in this data. In addition, the KCYPS provide survey periods instead of the specific interview dates. Consequently, the matched air pollution value was the mean value for the survey period, and this can limit the extent of variation of air pollution levels that could be studied. For this reason, air pollution in this data does not vary much throughout the years, there being only a 1 or 2 ($\mu g/m^3$) difference. Thus, for this analysis, pooled OLS is used instead

of individual fixed effect. For this reason, this analysis tried to include various fixed effects for house type, district size, year and other relevant control variables. This study also attempted to address the endogeneity problem of air pollution by including wind direction as an instrument.

In order to build an accurate picture of public opinions on the effect of air pollution on subjective well-being, this study included a number of interviews with school teachers on June 11, 2019 (2 teachers from elementary school and 1 teacher from middle school). The contents of the teachers' interviews corroborated the findings in both this study and previous relevant studies. Teachers who were interviewed commonly mentioned that children in their school often complain of headaches and eye aches on days when air pollution is reported to be high. Furthermore, according to the teacher's comments, some students expressed feeling depressed and less interested in school life due to the reduction of outdoor activities and physical education due to fine dust.

Based on the findings of this paper and schoolteachers' suggestions, we can suggest a few solutions regarding children's environment regarding the issue of air pollution. The first solution is simply to reduce air pollution nationally and internationally within the children's environment. According to the Sustainable Development Goals (SDGs), systemic changes are necessary for an environment-friendly system. Following the SDGs could be an effective first step in actively reducing pollution. Specifically, SDG no.7 replacing fossil fuels with renewable energy, and; SDG no.9 encouraging people to use public transportation need to be considered as soon as possible. In addition, as this paper confirmed the fact that air pollution can be affected by its trans-boundary characteristics (Air Korea, 2016; Jia & Ku, 2019), international cooperation and regulation on the issue of pollution should be prioritized.

Secondly, sufficient indoor facilities at schools and community centers should be provided for children. Teachers in the interview commonly stressed that indoor facilities can prevent school-aged children from being exposed to air pollution while not constraining children's

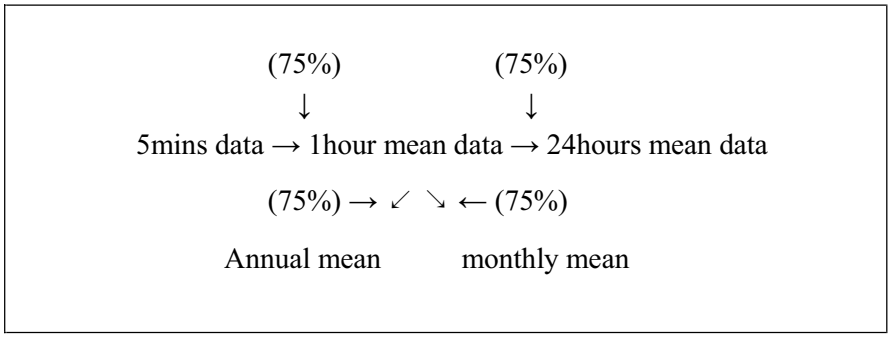
ability to do physical activities. However, they also pointed out that since there is a discrepancy in school facilities depending on the school budget, only those students in schools that can afford investing in such facilities would enjoy this benefit. Therefore, the government may need to conduct a full survey on school size and the availability of indoor facilities, and provide support for schools unable to finance appropriately sized and equipped indoor activity centers.

Lastly, thorough indoor air management is needed for schools and any other places where children spend their time. Currently, the South Korean government is installing air purifiers in areas with poor air quality as a pilot program that began at the end of the year 2017, and with the school health act revised on April 2, 2019, the mandatory installation of air purification facilities in classrooms at schools nationwide began from July 3, 2019 (School Health Act, 2019). Air purification facilities can not only help improve objective air quality, but can also affect subjective well-being by making people feel safer. This is confirmed by one of the interviewed schoolteachers, who, having worked at a school with air purification facilities before moving to a new school that lacked air purification, mentioned that the mere presence of air purification facilities gave psychological relief concerning air pollution, thereby improving students' learning atmosphere. At the same time, the installation of air purification facilities should consider class size and the level of children's activities in the class. Finally, the professional management of air purification facilities after installation should also be maintained to ensure proper function.

To sum up, air condition can be suggested as a new intangible objective well-being domain that can directly affect teenagers' subjective well-being. In addition, we need to take into consideration protecting children's development by providing well-established environmentally friendly settings to their life.

Appendix. A. Air Pollution Effective Processing Ratio

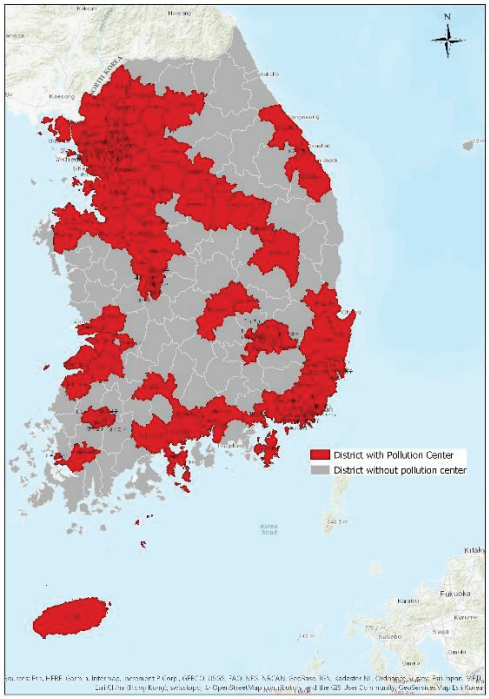
<An effective processing ratio>



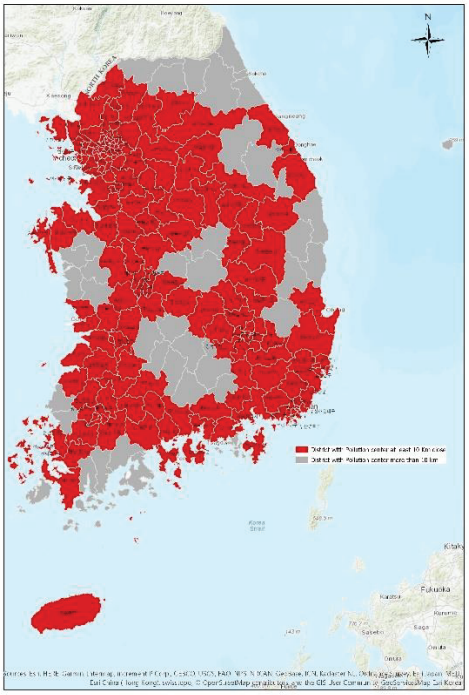
Source: Annual Report of Air quality(2016) translated into English

Appendix. B. The Location of Monitoring Centers

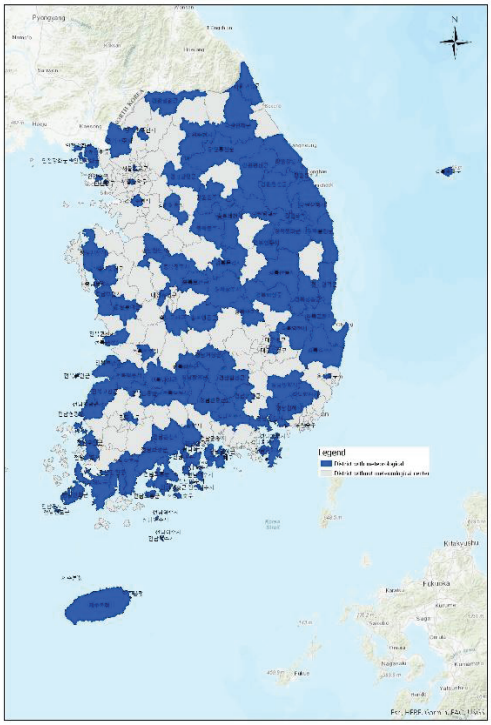
Air Pollution Monitoring Center



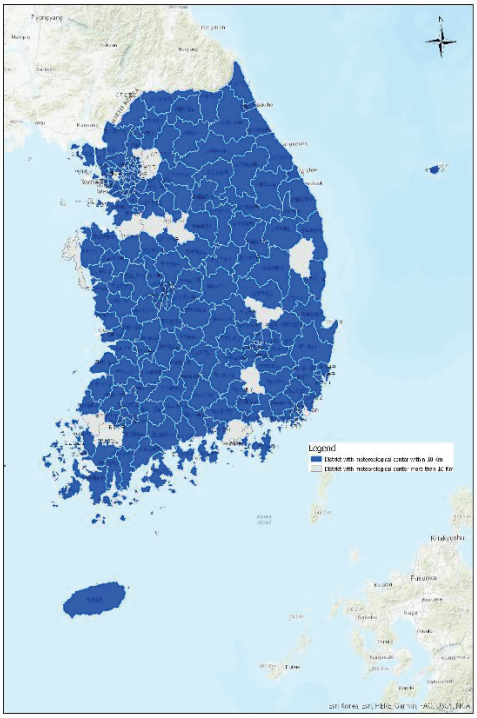
Air Pollution Monitoring Center
(A radius of 10km)



Automated Synoptic Observing System



Automated Synoptic Observing System
(A radius of 10km)



Appendix. C. The Effect of Air Pollution on Subjective Well-being (Second Stage)

Panel A. Second Stage				
	(1)	(2)	(3)	(4)
Dependent variable	Life Satisfaction	Positive	Negative	Depression
PM_{10} (μg/m^3)	-0.017**	-0.008	0.028***	0.133+
	(0.006)	(0.006)	(0.008)	(0.069)
Female	-0.082***	-0.126***	0.176***	1.949***
	(0.018)	(0.016)	(0.022)	(0.161)
Age	-0.022	-0.046*	0.047+	0.217
	(0.023)	(0.021)	(0.028)	(0.209)
Bullying	-0.001	-0.001	0.001	0.027**
	(0.001)	(0.001)	(0.002)	(0.009)
Coedu_school	0.036*	0.013	-0.102***	-0.154
	(0.017)	(0.016)	(0.021)	(0.155)
Peer relation	0.075***	0.078***	-0.039***	-0.677***
	(0.005)	(0.005)	(0.006)	(0.045)
Study environment	0.048***	0.043***	-0.034***	-0.355***
	(0.004)	(0.004)	(0.005)	(0.034)
Com environment	0.035***	0.030***	-0.047***	-0.054*
	(0.003)	(0.003)	(0.004)	(0.026)
Log income	0.030+	0.021	-0.014	-0.344**
	(0.017)	(0.014)	(0.017)	(0.121)
Mother education	0.003	0.003	-0.009	0.113
	(0.020)	(0.018)	(0.024)	(0.169)
Parents life satisfaction	0.036*	0.015	-0.038+	-0.072
	(0.017)	(0.015)	(0.020)	(0.143)
Weather condition	Yes	Yes	Yes	Yes
House type FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
_cons	-1.368	-0.128	2.402	45.280***
	(1.520)	(1.353)	(1.726)	(13.524)
N	9,911	9,911	9,911	8,089
R-sq.	0.133	0.149	0.065	0.142
Panel B. First Stage (Dependent variable: PM_{10} (μg/m^3))				
Excluded IV	(1)	(2)	(3)	(4)
W	4.666***	4.628***	4.665***	4.665***
	(0.290)	(0.322)	(0.290)	(0.290)
S	4.925***	4.261***	4.927***	4.927***
	(0.291)	(0.327)	(0.291)	(0.291)
N	7.217***	5.862***	7.222***	7.222***
	(0.481)	(0.424)	(0.481)	(0.481)
Included instrument	Yes	Yes	Yes	Yes
_cons	3.341	3.341	3.341	48.532**
	(13.385)	(13.385)	(13.385)	(16.086)
N	9,911	9,911	9,911	8,089
F-test(p-value)	112.78(0.00)	112.78(0.00)	112.78(0.00)	80.3(0.00)
Under identification (p-value)	244.01(0.00)	243.83(0.00)	244.01(0.00)	167.9(0.00)
Hansen J statistic (p-value)	0.69(0.71)	0.56(0.76)	1.85(0.39)	3.08(0.21)

Note: This table is full information of 2SLS, IV of <Table 2-2>. Robust standard errors are in parentheses. +p<0.10 * p<0.05, **p<0.01, ***p<0.001

Appendix. D. The Effect of Air Pollution on Subjective Well-being (OLS)

	(1)	(2)	(3)	(4)
Dependent variable	Life Satisfaction	Positive	Negative	Depression
PM_{10} (μg/m^3)	-0.003*	-0.001	0.003*	0.017
	(0.001)	(0.001)	(0.001)	(0.011)
Female	-0.098***	-0.134***	0.204***	2.085***
	(0.016)	(0.015)	(0.020)	(0.140)
Age	-0.020	-0.045*	0.045	0.206
	(0.023)	(0.021)	(0.028)	(0.207)
Bullying	-0.001	-0.001	0.001	0.028**
	(0.001)	(0.001)	(0.002)	(0.009)
Coedu_school	0.033+	0.011	-0.095***	-0.126
	(0.017)	(0.016)	(0.021)	(0.154)
Peer relation	0.075***	0.078***	-0.039***	-0.677***
	(0.005)	(0.005)	(0.006)	(0.045)
Study environment	0.048***	0.044***	-0.035***	-0.359***
	(0.004)	(0.004)	(0.005)	(0.034)
Com environment	0.035***	0.031***	-0.048***	-0.055*
	(0.003)	(0.003)	(0.004)	(0.026)
Log income	0.036*	0.024+	-0.023	-0.384**
	(0.017)	(0.014)	(0.017)	(0.118)
Mother education	0.011	0.007	-0.023	0.019
	(0.019)	(0.018)	(0.023)	(0.159)
Parents life satisfaction	0.034*	0.014	-0.035+	-0.053
	(0.017)	(0.015)	(0.019)	(0.142)
Weather condition	Yes	Yes	Yes	Yes
House type FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
_cons	-1.792	-0.336	3.135+	51.171***
	(1.481)	(1.343)	(1.669)	(12.796)
N	9,911	9,911	9,911	8,089
R-sq.	0.147	0.152	0.096	0.155

Note: This table is full information of OLS of <Table 2-2>. Robust standard errors are in parentheses.
+p<0.10 * p<0.05, **p<0.01, ***p<0.001

Appendix. E. Alternative Measures of Air Pollution: Annual mean of PM_{10} ($\mu g/m^3$)

	Panel A. Second Stage		
	(1)	(2)	(3)
	Life Satisfaction	Negative	Positive
Annual mean ; PM_{10} ($\mu g/m^3$)	-0.014*	0.023**	-0.008
	(0.006)	(0.007)	(0.005)
Female	-0.082***	0.177***	-0.124***
	(0.018)	(0.022)	(0.017)
Age	-0.022	0.048+	-0.046*
	(0.023)	(0.028)	(0.021)
Bullying	-0.001	0.001	-0.001
	(0.001)	(0.002)	(0.001)
Coedu_school	0.039*	-0.105***	0.015
	(0.017)	(0.021)	(0.016)
Peer relation	0.075***	-0.039***	0.078***
	(0.005)	(0.006)	(0.005)
Study environment	0.048***	-0.034***	0.043***
	(0.004)	(0.005)	(0.004)
Com environment	0.035***	-0.047***	0.030***
	(0.003)	(0.004)	(0.003)
Log income	0.034*	-0.020	0.023+
	(0.017)	(0.017)	(0.014)
Mother education	0.004	-0.011	0.002
	(0.020)	(0.023)	(0.018)
Parents life satisfaction	0.035*	-0.036+	0.015
	(0.017)	(0.020)	(0.015)
Weather condition	Yes	Yes	Yes
House type FE	Yes	Yes	Yes
District FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
_cons	-0.770	1.471	0.260
	(1.578)	(1.794)	(1.408)
N	9,911	9,911	9,911
R-sq.	0.141	0.079	0.149
Panel B. First Stage (Dependent variable: Annual mean PM_{10} ($\mu g/m^3$))			
	(1)	(2)	(3)
W	5.563***	5.563***	5.565***
	(0.296)	(0.296)	(0.296)
S	5.867***	5.867***	5.865***
	(0.299)	(0.299)	(0.299)
N	7.100***	7.100***	7.096***
	(0.498)	(0.498)	(0.498)
_cons	52.152***	52.152***	52.273***
	(13.813)	(13.813)	(13.816)
N	9,911	9,911	9,911
F-test(p-value)	138.3(0.00)	138.2(0.00)	138.2(0.00)
Under identification (p-value)	242.4(0.00)	242.3(0.00)	242.3(0.00)
Hansen J statistic (p-value)	1.74(0.42)	4.4(0.11)	0.18(0.91)

Note: This table is the details about the panel A. of <Table 2-3>. Robust standard errors are in parentheses. +p<0.10 * p<0.05, **p<0.01, ***p<0.001

Appendix. F. Alternative Measures of Air Pollution: log PM_{10} ($\mu g/m^3$) during survey period

	Panel A. Second Stage		
	(1)	(2)	(3)
	Life Satisfaction	Negative	Positive
log PM_{10} ($\mu g/m^3$)	-0.717**	1.172***	-0.356
	(0.264)	(0.329)	(0.248)
Female	-0.082***	0.176***	-0.126***
	(0.018)	(0.022)	(0.016)
Age	-0.021	0.046	-0.045*
	(0.023)	(0.028)	(0.021)
Bullying	-0.001	0.001	-0.001
	(0.001)	(0.002)	(0.001)
Coedu_school	0.037*	-0.102***	0.014
	(0.017)	(0.021)	(0.016)
Peer relation	0.075***	-0.039***	0.078***
	(0.005)	(0.006)	(0.005)
Study environment	0.048***	-0.034***	0.044***
	(0.004)	(0.005)	(0.004)
Com environment	0.035***	-0.048***	0.030***
	(0.003)	(0.004)	(0.003)
Log income	0.030+	-0.014	0.021
	(0.017)	(0.017)	(0.014)
Mother education	0.004	-0.011	0.003
	(0.020)	(0.023)	(0.018)
Parents life satisfaction	0.036*	-0.038+	0.015
	(0.017)	(0.020)	(0.015)
Weather condition	Yes	Yes	Yes
House type FE	Yes	Yes	Yes
District FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
_cons	0.435	-0.541	0.780
	(1.756)	(2.017)	(1.578)
N	9,911	9,911	9,911
R-sq.	0.134	0.067	0.148
Panel B. First Stage (Dependent variable: log PM_{10} ($\mu g/m^3$))			
	(1)	(2)	(3)
W	0.110***	0.110***	0.110***
	(0.007)	(0.007)	(0.007)
S	0.119***	0.119***	0.119***
	(0.007)	(0.007)	(0.007)
N	0.165***	0.165***	0.165***
	(0.012)	(0.012)	(0.012)
_cons	2.582***	2.582***	2.582***
	(0.316)	(0.316)	(0.316)
N	9,911	9,911	9,911
F-test(p-value)	99.29(0.00)	99.29(0.00)	99.21(0.00)
Under identification (p-value)	221.64(0.00)	221.63(0.00)	221.45(0.00)
Hansen J statistic (p-value)	0.99(0.61)	2.48(0.29)	0.48(0.79)

Note: This table contains the details about panel B. of <Table 2-3>. Robust standard errors are in parentheses. +p<0.10 * p<0.05, **p<0.01, ***p<0.001

Appendix. G. Alternative Measures of Air Pollution: Annual mean $PM_{2.5}$ ($\mu g/m^3$)

Panel A. Second Stage			
	(1)	(2)	(3)
	Life Satisfaction	Negative	Positive
Annual mean $PM_{2.5}$ ($\mu g/m^3$)	-0.018	0.036**	-0.006
	(0.011)	(0.012)	(0.010)
Female	-0.070	0.210***	-0.121**
	(0.045)	(0.058)	(0.041)
Age	-0.073	0.129+	-0.048
	(0.059)	(0.077)	(0.052)
Bullying	0.008***	-0.010***	0.007***
	(0.001)	(0.001)	(0.001)
Coedu_school	0.117*	-0.140*	0.034
	(0.047)	(0.056)	(0.042)
Peer relation	0.079***	-0.043**	0.090***
	(0.014)	(0.017)	(0.012)
Study environment	0.040***	-0.032*	0.033***
	(0.010)	(0.013)	(0.009)
Com environment	0.023**	-0.046***	0.028**
	(0.009)	(0.010)	(0.009)
Log income	0.157***	-0.079	0.125**
	(0.047)	(0.058)	(0.043)
Mother education	0.021	-0.037	0.030
	(0.054)	(0.061)	(0.049)
Parents life satisfaction	0.031	-0.001	-0.002
	(0.055)	(0.062)	(0.050)
Weather condition	Yes	Yes	Yes
House type FE	Yes	Yes	Yes
District FE	Yes	Yes	Yes
_cons	-0.649	6.237	1.843
	(4.701)	(5.844)	(4.352)
N	1,156	1,156	1,156
R-sq.	0.166	0.134	0.190
Panel B. First Stage (Dependent variable: Annual mean $PM_{2.5}$ ($\mu g/m^3$))			
	(1)	(2)	(3)
W	-2.740***	-2.740***	-2.740***
	(0.464)	(0.464)	(0.464)
S	-4.965***	-4.965***	-4.965***
	(0.412)	(0.412)	(0.412)
N	3.936***	3.936***	3.936***
	(0.531)	(0.531)	(0.531)
_cons	146.032***	146.032***	146.032***
	(14.752)	(14.752)	(14.752)
N	1,156	1,156	1,156
F-test(p-value)	300.8(0.00)	300.8(0.00)	300.83(0.00)
Under identification (p-value)	144.84(0.00)	144.84(0.00)	144.84(0.00)
Hansen J statistic (p-value)	0.11(0.95)	1.84(0.40)	1.38(0.50)

Note: This table is the details about the panel C. of <Table 2-3>. Robust standard errors are in parentheses. +p<0.10 * p<0.05, **p<0.01, ***p<0.001

Appendix. H. Alternative Measures of Air Pollution: log $PM_{2.5}$ ($\mu g/m^3$) during survey period

Panel A. Second Stage			
	(1) Life Satisfaction	(2) Negative	(3) Positive
log $PM_{2.5}$ ($\mu g/m^3$)	-0.347	0.772***	-0.124
	(0.230)	(0.221)	(0.204)
Female	-0.064	0.167**	-0.122**
	(0.042)	(0.055)	(0.039)
Age	-0.068	0.088	-0.048
	(0.053)	(0.069)	(0.048)
Bullying	-0.007	0.006	-0.003
	(0.004)	(0.008)	(0.003)
Coedu_school	0.081+	-0.081	0.012
	(0.044)	(0.051)	(0.038)
Peer relation	0.073***	-0.047**	0.083***
	(0.013)	(0.016)	(0.012)
Study environment	0.046***	-0.033**	0.040***
	(0.010)	(0.011)	(0.009)
Com environment	0.022**	-0.049***	0.024**
	(0.008)	(0.010)	(0.008)
Log income	0.128**	-0.042	0.093*
	(0.044)	(0.056)	(0.041)
Mother education	0.006	-0.014	0.023
	(0.050)	(0.057)	(0.045)
Parents life satisfaction	0.016	0.005	-0.004
	(0.048)	(0.054)	(0.045)
Weather condition	Yes	Yes	Yes
House type FE	Yes	Yes	Yes
District FE	Yes	Yes	Yes
_cons	-0.275	0.433	1.573
	(3.732)	(4.569)	(3.548)
N	1,320	1,320	1,320
R-sq.	0.153	0.115	0.176
Panel B. First Stage (Dependent variable: log $PM_{2.5}$ ($\mu g/m^3$))			
	(1)	(2)	(3)
W	0.057*	0.057*	0.057*
	(0.028)	(0.028)	(0.028)
S	-0.074***	-0.074***	-0.074***
	(0.016)	(0.016)	(0.016)
N	0.386***	0.386***	0.386***
	(0.030)	(0.030)	(0.030)
_cons	8.815***	8.815***	8.815***
	(0.891)	(0.891)	(0.891)
N	1,320	1,320	1,320
F-test(p-value)	133.0(0.00)	133.0(0.00)	133.0(0.00)
Under identification (p-value)	106.3(0.00)	106.3(0.00)	106.3(0.00)
Hansen J statistic (p-value)	1.11(0.57)	0.05(0.98)	4.64(0.1)

Note: This table is the details about the panel D of <Table 2-3>. Robust standard errors are in parentheses. +p<0.10 * p<0.05, **p<0.01, ***p<0.001

Appendix. I. The Validity of Instrument Variable

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable (Life Satisfaction)	Main result from Table 2	Including other exogenous variable		Instrumenting wind direction for other weather condition		Wind direction as exogenous variable
			Panel A: Two-Stage Least Squares			
PM_{10} ($\mu g/m^3$)	-0.017**	-0.022**	-0.021**	-0.003*	-0.003*	-0.009*
	(0.006)	(0.008)	(0.008)	(0.001)	(0.001)	(0.004)
log_rain (mm)	-0.060+	-0.064+	-0.106*	-0.129		
	(0.032)	(0.033)	(0.053)	(0.153)		
Surface air pressure	0.003*	0.003+	0.004*		0.005	
	(0.001)	(0.002)	(0.002)		(0.006)	
Number of factory		0.000				
		(0.000)				
Car registration		0.086				
		(0.175)				
Number of disease			-0.029			
			(0.019)			
BMI			-0.000			
			(0.003)			
W						-0.029
						(0.039)
S						-0.026
						(0.040)
N						-0.084
						(0.053)
Control	Y	Y	Y	Y	Y	Y
FE	Y	Y	Y	Y	Y	Y
			Panel B: First Stage for pm10			
W	4.666***	3.198***	3.796***	0.049**	0.655**	
	(0.29)	(0.287)	(0.327)	(0.017)	(0.200)	
S	4.925***	3.490***	3.740***	-0.059***	-2.079***	
	(0.291)	(0.293)	(0.326)	(0.016)	(0.201)	
N	7.217***	5.393***	6.085***	0.074***	-3.899***	
	(0.481)	(0.449)	(0.469)	(0.019)	(0.294)	
Controls	Y	Y	Y	Y	Y	Y
F-test(p-value)	112.78(0.00)	60(0.00)	64(0.00)	137(0.00)	252.5(0.00)	703(0.00)
Underidentification(p-value)	244.01(0.00)	159(0.00)	158(0.00)	383(0.00)	630(0.00)	859(0.00)
Hansen J (p-value)	0.69(0.71)	0.39(0.82)	0.74(0.69)	7.14(0.03)	6.9(0.03)	0.52(0.47)
N	9,911	9,818	7,830	9,911	9,911	9,845
R-sq.	0.133	0.123	0.127	0.146	0.147	0.145

Note: Robust standard errors are in parentheses. * p<0.05, **p<0.01, ***p<0.001 Column (1) is the main result of life satisfaction from <Table 2-2>. Columns (2) and (3) included other exogenous variables that could be associated with air pollution and subjective well-being. Columns (4) and (5) are instrument wind direction for other weather condition; log rain, surface air pressure but wind direction did not affect subjective well-being through those weather condition. Column (6) reports the regression in which wind direction is included as an exogenous variable and the pm10 is instrumented using the alternative instrument.

Appendix J. Alternative Weather Instruments for Air Pollution

Second Stage									
Instrument for pm10	log rain			Air pressure			Air pressure & Mean wind speed		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	LS	Negative	Positive	LS	Negative	Positive	LS	Negative	Positive
PM_{10}	0.027	-0.082*	0.019	0.071	0.013	0.050	0.024	0.017	0.035
	(0.024)	(0.033)	(0.023)	(0.045)	(0.045)	(0.041)	(0.019)	(0.022)	(0.018)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
FEs	Y	Y	Y	Y	Y	Y	Y	Y	Y
_cons	-1.068	8.743***	0.101	-3.582	3.224	-1.687	-0.877	2.996*	-0.813
	(1.449)	(1.965)	(1.353)	(2.660)	(2.633)	(2.381)	(1.167)	(1.347)	(1.104)
N	9,916	9,916	9,916	9,916	9,916	9,916	9,916	9,916	9,916
R-square	0.085	-0.269	0.121	-0.226	0.089	-0.052	0.098	0.084	0.051
F-test for first stage (p-value)	21(0.00)	21(0.00)	21(0.00)	8.2(0.00)	8.2(0.00)	8.2(0.00)	18(0.00)	18(0.00)	18(0.00)

Note: This table tried to use other instruments due to the concerns about weather condition that might affect subjective well-being through air pollution. The columns 1 through 3 used log rain, columns 4 through 6 for air pressure and columns 7 through 9 for two instruments air pressure and mean wind speed. However, the validity of instruments showed different results in each column. The log rain (columns 1 through 3) is technically valid as an IV but it was strongly correlated with subjective well-being in the main model. The air pressure (columns 4 through 6) was a weak instrument checked by F-test and air pollution was not significant. Lastly even though the air pressure and mean wind speed in columns 7 through 9 were satisfied both F-test and Hansen J, there was no statistical significance on air pollution.

Appendix. K. The Effect of Air Pollution on Subjective Well-being (FE)

Panel A. Second Stage			
	(1)	(2)	(3)
	LS	Negative	Positive
Pm10	0.013	0.024	0.001
	(0.025)	(0.032)	(0.024)
Control/Weather	Y	Y	Y
House type FE	Y	Y	Y
District FE	Y	Y	Y
Year FE	Y	Y	Y
Individual FE	Y	Y	Y
N	7,483	7,483	7,483
N(id)	1,993	1,993	1,993
R-sq.	0.038	0.022	0.048
Panel B. First Stage (Dependent variable: pm10)			
W	0.51	0.51	0.51
	(0.41)	(0.41)	(0.41)
S	1.21	1.21	1.21
	(0.37)	(0.37)	(0.37)
N	1.28	1.28	1.27
	(0.56)	(0.56)	(0.56)
Included instrument	Y	Y	Y
F-test(p-value)	8.76(0.00)	8.76(0.00)	8.73(0.00)
Under identification(p-value)	26.6(0.00)	26.6(0.00)	26.5(0.00)
Hansen J (p-value)	1.98(0.36)	4.12(0.12)	5.7(0.05)

Note: This table reports the estimates of the main model analyzed by the individual fixed effect. The air pollution is the average air pollution of the survey period since the data KCYPS did not provide the specific 'survey date and time'. That is why there was not enough variation in air pollution throughout each year. The main model in this study <Table 2-2> used pooled OLS, IV. Robust standard errors are in parentheses. * p<0.05, **p<0.01, ***p<0.001

References

Adams, S., & Savahl, S. (2017). Children's Discourses of Natural Spaces: Considerations for children's Subjective Well-Being. *Child Indicators Research*, *10*(2), 423–446.

Adair-Rohani, H. (2018). *Air Pollution and Child Health: Prescribing Clean Air*. World Health Organization.

Almond, D., Mazumder, B., & Ewijk, R. (2015). In utero Ramadan exposure and children's academic performance. *The Economic Journal*, *125*(589), 1501–1533.

Angrist, J. D., & Pischke, J. S. (2008). *Mostly harmless econometrics: an empiricist's companion*. Princeton University Press.

Angrist, J. D., & Evans, W. N. (1996). *Children and their parents' labor supply: Evidence from exogenous variation in family size* (No. w5778). National bureau of economic research.

Air Korea. (2016). 2016 Annual Report for Air Environment. Retrieved from https://www.airkorea.or.kr/web/detailViewDown?pMenu_No=125.

Baek, D., Altindag, D. T., & Mocan, N. (2015). *Chinese Yellow Dust and Korean Infant Health*. National Bureau of Economic Research.

Baek, J. S. (2016). The Effect of Subway Opening on Air Quality. *Korea Review of Applied Economics, 18*(2), 53-76.

Ben-Arieh, A. (2008). The child indicators movement: Past, present, and future. *Child Indicators Research*, *1*(1), 3-16.

Bradshaw, J., Martorano, B., Natali, L., & de Neubourg, C. (2013). Children's Subjective Well-Being in Rich Countries. *Child Indicators Research*, *6*(4), 619-635.

Bradshaw, J. (2015). Subjective well-being and social policy: Can nations make their children happier? *Child indicators research, 8*(1), 227-241.

Bradshaw, J., & Rees, G. (2017). Exploring national variations in child subjective well-being. *Children and Youth Services Review*, *80*, 3-14.

Brereton, F., Clinch, J. P., & Ferreira, S. (2008). Happiness, geography and the environment. *Ecological Economics*, *65*(2), 386–396.

Bronfenbrenner, U. (1979). *The Ecology of Human Development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.

Casas, F. (2017). Analysing the comparability of 3 multi-item subjective well-being psychometric scales among 15 countries using samples of 10 and 12-year-olds. *Child Indicators Research*, *10*(2), 297–330.

Cen, X., Lo, H. K., & Li, L. (2016). A framework for estimating traffic emissions: The development of Passenger Car Emission Unit. *Transportation Research Part D: Transport and Environment*, *44*,

78–92.

Challinor, A. J., Adger, W. N., & Benton, T. G. (2017). Climate risks across borders and scales. *Nature Climate Change*, *7*(9), 621.

Chen, S., Guo, C., & Huan, X. (2018). Air pollution, student health, and school absences: Evidence from China. *Journal of Environmental Economics and Management*, *92,* 465-497.

Chen, X., Zhang, X., & Zhang, X. (2017). *Smog in our brains: Gender differences in the impact of exposure to air pollution on cognitive performance in China* (Vol. 1619). Intl Food Policy Res Inst.

Chiu, Y.-H. M., Hsu, H.-H. L., Coull, B. A., Bellinger, D. C., Kloog, I., Schwartz, J., … Wright, R. J. (2016). Prenatal particulate air pollution and neurodevelopment in urban children: examining sensitive windows and sex-specific associations. *Environment International*, *87*, 56–65.

Clifford, A., Lang, L., Chen, R., Anstey, K. J., & Seaton, A. (2016). Exposure to air pollution and cognitive functioning across the life course–A systematic literature review. *Environmental Research*, *147*, 383–398.

Currie, J., Hanushek, E. A., Kahn, E. M., Neidell, M., & Rivkin, S. G. (2009). DOES POLLUTION INCREASE SCHOOL ABSENCES? *The Review of Economics and Statistics*, *91*(4), 682–694.

Diener, E. (1984). Subjective well-being. *Psychological Bullertin, 193*, 542-575.

Diener, E. Scollon, C.N. & Lucas, R.E. (2003). The evolving concept of subjective well-being; The multifaceted nature of happiness. *Advanced in Cell Aging and Geronrolgy, 13*, 187-219.

Degraeuwe, B., Thunis, P., Clappier, A., Weiss, M., Lefebvre, W., Janssen, S., & Vranckx, S. (2017). Impact of passenger car NOX emissions on urban NO2 pollution–Scenario analysis for 8 European cities. *Atmospheric environment*, *171*, 330-337.

Emetere, M. E., Akinyemi, M. L., & Uno, U. E. (2015, August). Computational analysis of aerosol dispersion trends from cement factory. In *2015 International Conference on Space Science and Communication (IconSpace)* (pp. 288-291). IEEE.

Esposito, S., Galeone, C., Lelii, M., Longhi, B., Ascolese, B., Senatore, L., … Patria, M. F. (2014). Impact of air pollution on respiratory diseases in children with recurrent wheezing or asthma. *BMC Pulmonary Medicine*, *14*(1), 130.

Evans, G. W. (2006). Child Development and the Physical Environment. *Annual Review of Psychology*, *57*(1), 423–451.

Ferrer-i-Carbonell, A., & Frijters, P. (2004). How important is methodology for the estimates of the determinants of happiness? *Economic Journal, 114*(497), 641-659.

Gariepy, G., Elgar, F. J., Sentenac, M., & Barrington-Leigh, C. (2017). Early-life family income and subjective well-being in adolescents. *PloS one*, *12*(7), e0179380.

Gauderman, W. J., Urman, R., Avol, E., Berhane, K., McConnell, R., Rappaport, E., … Gilliland, F. (2015). Association of improved air quality with lung development in children. *New England Journal of Medicine*, *372*(10), 905–913.

Guarnieri, M., & Balmes, J. R. (2014). Outdoor air pollution and asthma. *The Lancet*, *383*(9928), 1581–1592.

Gilman, R., & Huebner, S. (2003). A review of life satisfaction research with children and adolescents. *School Psychology Quarterly*, *18*(2), 192.

Goswami, H. (2012). Social relationships and children's subjective well-being. *Social Indicators Research*, *107*(3), 575-588.

Hajat, A., Hsia, C., & O'Neill, M. S. (2015). Socioeconomic disparities and air pollution exposure: a global review. *Current environmental health reports*, *2*(4), 440-450.

Helliwell, J., Layard, R., & Sachs, J. (Eds.) (2012). *World Happiness Report*. New York: Earth Institute, Columbia University.

Helliwell, J. Layard, R., & Sachs, J. (Eds.) (2015). *World Happiness Report 2015.* New York: Sustainable Development Solutions Network.

Helliwell, J., Layard, R., & Sachs, J. (Eds.) (2016). *World Happiness Report 2016, Update (Vol. I)*. New York: Sustainable Development Solutions Network.

Huebner, E. S. (1991). Initial development of the student's life satisfaction scale. *School Psychology International*, *12*(3), 231–240.

Huebner, E. S., & Dew, T. (1996). The interrelationships of positive affect, negative affect, and life satisfaction in an adolescent sample. *Social Indicators Research*, *38*(2), 129–137.

Jia, R. & Ku, H. (2019). Is China's Pollution the Culprit for the Choking of South Korea? Evidence from the Asian Dust, *The Economic Journal*, uez021.

Kerret, D., Orkibi, H., & Ronen, T. (2014). Green perspective for a hopeful future: Explaining green schools' contribution to environmental subjective well-being. *Review of General Psychology*, *18*(2), 82-88.

Kim, S. Y., Lim, J. Y., Kim, S. W., Park, S. H., Yoo, S. Y., Choi, J. Y., & Shin, W. Y. (2006). *Korea youth development indicator I*, Seoul: National Youth Policy Institute.

Kim, K. I., Kim, J. H., & Won, H. T. (1984). *Symptom Checklist 90-Revised (SCL-90-R).* Central Adaptation Research Center.

Kousky, C. (2016). Impacts of natural disasters on children. *The Future of Children*, 26(1), 73-92.

Lampropoulou, A. (2018). Personality, school, and family: What is their role in adolescents' subjective well-being. *Journal of Adolescence*, *67*, 12–21.

Lau, A. L. D., Cummins, R. A., & Mcpherson, W. (2005). An investigation into the cross-cultural equivalence of the Personal Wellbeing Index. *Social Indicators Research*, *72*(3), 403–430.

Lee, B. J., & Yoo, M. S. (2015). Family, school, and community correlates of children's subjective well-being: An international comparative study. *Child Indicators Research*, *8*(1), 151-175.

Lee, B. J., & Yoo, M. S. (2017). What accounts for the variations in children's subjective well-being across nations?: A decomposition method study. *Children and Youth Services Review*, *80*, 15–21.

Lemke, L. D., Lamerato, L. E., Xu, X., Booza, J. C., Reiners Jr, J. J., Raymond Iii, D. M., … Krouse,

H. J. (2014). Geospatial relationships of air pollution and acute asthma events across the Detroit–Windsor international border: Study design and preliminary results. *Journal of Exposure Science and Environmental Epidemiology*, *24*(4), 346.

Liu, H., & Salvo, A. (2018). Severe Air Pollution and child absences when schools and parents respond. *Journal of Environmental Economics and Management, 92,* 300-330.

Luechinger, S. (2010). Life satisfaction and transboundary air pollution. *Economics Letters*, *107*(1), 4-6.

Marino, C., Nucara, A., Pietrafesa, M., & Pudano, A. (2016). The assessment of road traffic air pollution by means of an average emission parameter. *Environmental Modeling & Assessment*, *21*(1), 53-69.

Midouhas, E., Kokosi, T., & Flouri, E. (2018). Outdoor and indoor air quality and cognitive ability in young children. *Environmental Research*, *161*, 321–328.

Ministry of Environment. (2019). Action Plan for Fine Dust Alert. Retrieved from https://www.me.go.kr/home/web/index.do?menuId=64.

Mohai, P., Kweon, B. S., Lee, S., & Ard, K. (2011). Air pollution around schools is linked to poorer student health and academic performance. *Health Affairs*, *30*(5), 852–862.

OECD. (2013 a). *Health at a glance. OECD Indicators*. Paris: OECD publishing.

OECD. (2013 b). *OECD Guidelines on Measuring Subjective Wellbeing*. Paris: OECD Publishing.

OECD. (2014). *Education at a glance 2014. OECD Indicators.* Paris: OECD publishing.

OECD. (2015). *How's Life? 2015: Measuring Well-being*. Paris: OECD publishing.

Oita, A., Malik, A., Kanemoto, K., Geschke, A., Nishijima, S., & Lenzen, M. (2016). Substantial nitrogen pollution embedded in international trade. *Nature Geoscience*, *9*(2), 111-117.

Park, K., & Wang, S. (2018). Youth Activities and Children's Subjective Well-Being in Korea. *Journal of Happiness Studies*, 1-15.

Park, J. (2017). The Relationships of Adolescent Academic Stress, School Violence and Subjective Happiness: Focusing on the Mediating Pathway of Friend, Family and Teacher`s Support. *Social Science Studies, 43*(2). 263-289.

Pople, L., Rees, G., Main, G., & Bradshaw, J. (2015). *The good childhood report*. London: The Children's Society.

Rees, N. (2016). *Clear the air for children: the impact of air pollution on children*. Chile: UNICEF.

Sarriera, J. C., Casas, F., Bedin, L., Abs, D., Strelhow, M. R., Gross-Manos, D., & Giger, J. (2015). Material resources and children's subjective well-being in eight countries. *Child Indicators Research*, *8*(1), 199–209.

Savahl, S., Montserrat, C., Casas, F., Adams, S., Tiliouine, H., Benninger, E., & Jackson, K. (2019). Children's Experiences of Bullying Victimization and the Influence on Their Subjective Well-Being: A Multinational Comparison. *Child development*, *90*(2), 414-431.

Seo, K. H. (2016). Academic Stresses, Subjective Well-being, and Feeling of Happiness in Adolescence:

Focused on Roles of Resilience. *Korea Youth Studies, 23*(11). 137-157.

Sung, E., & Kim, G. (2013). The structural relationships analysis among happiness, personal traits, and environmental traits of adolescents using the structural equation modeling. *Studies on Korean Youth*, *24*(4), 177–202.

van Kempen, E., Fischer, P., Janssen, N., Houthuijs, D., van Kamp, I., Stansfeld, S., & Cassee, F. (2012). Neurobehavioral effects of exposure to traffic-related air pollution and transportation noise in primary schoolchildren. *Environmental Research*, *115*, 18–25.

Veenhoven, R. (2012). Cross-national differences in happiness: Cultural measurement bias or effect of culture? *International Journal of Wellbeing*, *2*(4), 333-353.

Wang, S. (2015). *Measuring and explaining subjective well-being in Korea*, Seoul: Korea Development Institute.

Wells, N. M., & Evans, G. W. (2003). Nearby nature: A buffer of life stress among rural children. *Environment and Behavior*, *35*(3), 311–330.

Welsch, H. (2006). Environment and happiness: Valuation of air pollution using life satisfaction data. *Ecological Economics*, *58*(4), 801–813.

WHO (2006). *Air Quality Guidelines Global Updates 2005*. Denmark: WHO Regional Office for Europe.

Yuan, L., Shin, K., & Managi, S. (2018). Subjective Well-being and Environmental Quality: The Impact of Air Pollution and Green Coverage in China. *Ecological Economics*, *153*, 124–138.

Yoo, M. S. (2016). *Factors associated with children's subjective well-being*. PhD Dissertation; Seoul National University.

Youm, Y. S., Kim, K. M., Sung, Y. C., & Lee, S. W. (2018). *10th Korea Children Adolescent Happiness Index. Seoul: Korea Bhang Jeong Hwan Foundation*, Institute for Social Development Studies

Yoo, J. P., & Choi, C. (2016). How do family economic contexts affect children's subjective well-being? A study of South Korea. *Child Indicators Research*, *9*(4), 949-970.

Zhang, X., Zhang, X., & Chen, X. (2017). Happiness in the air: How does a dirty sky affect mental health and subjective well-being? *Journal of Environmental Economics and Management*, *85*, 81–94.

Clean Air Conservation Act. Act no. 16266. (2019).

Fine Dust Reduction and Management Act. Act no. 15718. (2019).

Enforcement Decree of Fine Dust Reduction and Management Act. Act no. 29514. (2019).

Elementary and Secondary Education Act, Act no. 14603. (2017).

School Health Act. Act.no. 15534. (2019).

Chapter 3

The Effect of Multicultural Policy on Multicultural Children's Subjective Well-being

Abstract

This study explores the effect of multicultural policy on multicultural children's subjective well-being in South Korea. Since 2010, the South Korea has been working to establish a systemic master plan for policies on multicultural families due to the growing number of multicultural families in South Korea. Such policies could improve children's objective well-being, increase participation in education and other essential social activities, as well as reduce the various risks associated with their multicultural status. However, the subjective well-being aspect of this policy still remains a subject of debate. Using the Multicultural Adolescent Panel Study data (N=8,634, grades 4 to 9) collected from 2011 to 2016, this study evaluates the benefits of the policy on children's subjective well-being using individual fixed effects. The results showed that policy benefits increase significantly children's 'positive affect', and reduce 'negative affect' during their elementary school period (the year 2011-2013). However, when analyzing middle school children, the direction of the effect changed to the opposite.

3.1. Introduction

The immigrant population in South Korea has been growing since the late 1980s, driven largely by an increase in the number of international marriages. Notably, since 2000, there has been a massive influx of Southeast Asian women via private matchmaking agencies mostly targeting the imbalanced marriage market for males in rural areas or those of lower socio-economic status (Kim, 2018). With the growing number of multicultural families, the children born to those families have also been on the rise. According to Education Statistics (2018), the number of multicultural students has been increasing by over 10,000 every year for recent 5 years, with 67,806 multicultural students in 2014, and over 122,212 by 2018.

In spite of multicultural families becoming increasingly common, many multicultural children in school have reported facing difficulties including discrimination based on physical appearance, and communication problems due to the language barrier, even though a significant number of the children had either been born in South Korea or had been living in South Korea for most of their lives (Nam & Kim, 2018). In the current analysis outlined in the National Survey of Multicultural Families (2019), 9.2 percent of multicultural children reported experiencing discrimination in the course of their lives due to their multicultural status (Ministry of Gender Equality and Family, 2013, 2016, 2019). Moreover, these negative experiences tend to bring on school adaptation problems, with the effects being worse for those of lower socioeconomic status (Kim & Park, 2018; Lee & Chang, 2018).

Previous studies demonstrate the correlation between these adverse life experiences and multicultural children's subjective well-being, emphasizing the roles of family, school teachers, and friends in supporting children's subjective well-being by acting as a buffer against negative experiences, promoting emotional resilience and helping prevent severe psychological complications such as depression (Baek, Park, & Chung, 2018; Chun & Lee, 2015; Park & Yang, 2017). Studies in the fields of psychology and sociology have similarly analyzed

strategies for maintaining psychological health in multicultural children, demonstrating a strong correlation between self-esteem, self-resilience and children's subjective well-being (An, Lee, & Lim, 2013; Lee & Chung, 2016). In addition to these internal factors, researchers have also emphasized the importance of external aid in improving subjective well-being. An example of external intervention could be developing a national policy aiming to improve children's lives in the social sphere beyond the family, especially as their life boundaries expand from the family unit to school, and then to society (Bradshaw, 2015).

Traditionally, policies aimed at multicultural children in immigrant-receiving countries such as the US and Canada have focused on children's language skills so as to help children adapt to school life, increase their social participation and reduce the likelihood of discrimination (Park, 2018). In the case of the UK and France, most multicultural policies so far have targeted underprivileged multicultural children (Kim & Ko, 2018). In South Korea, various types of support have been offered systematically to multicultural children as a universal provision, including educational mentoring services, cultural education, participation in formative activities, several incentive offers, and language education (Ministry of Gender Equality and Family, 2016).

However, existing studies on multicultural policy have focused solely on factor analysis to either determine which kind of program enjoyed the greatest popularity among multicultural children, or measure the actual increase in children's' cognitive capabilities, such as educational attainment, as a result of the program (Kim & Ko, 2018; Oh & Park, 2018). Even though one recent study used subjective well-being as a mediating effect between the policy benefits and educational outcome (Oh & Park, 2018), the question of the direct effect of multicultural policies per se on children's subjective well-being has not yet been discussed.

This study explores any meaningful changes in multicultural children's lives brought about by multicultural policy, using their subjective well-being as an outcome. Subjective well-being

consists of three measures: (1) positive affect; (2) negative affect; (3) overall life satisfaction. The empirical analysis used individual fixed effects based on the Multicultural Adolescents Panel Study (MAPS), a nationally representative panel data set collected from 2011 to 2016.

This study found that the policy programs increased positive affect and decreased negative affect during the elementary school period. However, in middle school, the effect of policy programs on multicultural children's subjective well-being was shown to be reversed. The effects also differed by gender and household income.

The remainder of this paper is organized as follows: Section 3.2 contains the theoretical framework and literature review; Section 3.3 describes the data and methodology; Section 3.4 and presents the main results and additional analysis, including robustness check and heterogeneity analysis; Section 3.5 contain the conclusion.

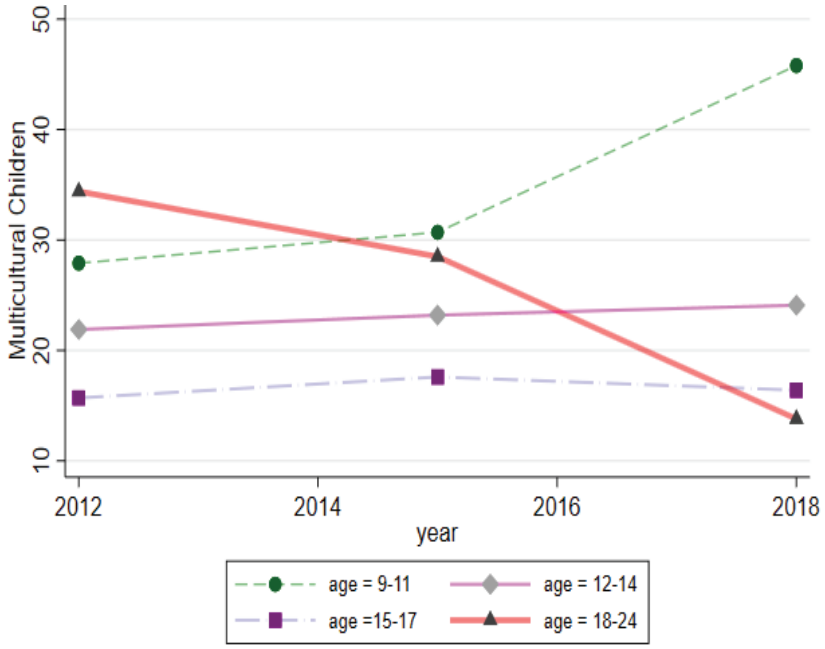
3.2. Theoretical Framework and Literature

3.2.1. Multicultural Children

The term 'multicultural children' refers to children who are born and raised in multicultural families that are legally defined as families formed by marriages between an immigrated foreigner and a South Korean national. Children born to foreign parents living in South Korea, or children who grew up in the home country of a foreign parents and subsequently moved to South Korea are also defined as multicultural children (Multicultural Families Support Act, 2018; Framework Act on Treatment of Foreigners Residing in the Republic of Korea, 2017; Enforcement Decree of the Elementary and Secondary Education Act, 2018; Youth Welfare Support Act, 2017). Appendix A. presents a more detailed definition of the term 'multicultural children' within the context of various laws. According to the Ministry of Gender Equality and Family (2019), 85.7 percent of multicultural families in South Korea are formed through international marriages. Among them, Families with children constitute 46.3 percent.

Recently, the number of multicultural children in South Korea has been increasing steadily due to the increased settlement rate of multicultural families (67 percent of which remain in South Korea for over 10 years). <Figure 3-1> illustrates how the size of each age cohort of multicultural children in South Korea has changed in the period between 2012 and 2018. Notably, the data showed an upward trend in the share of the children aged between 9 and 11 (Ministry of Gender Equality and Family, 2019; Education Statistics, 2018).

<Figure 3-1> The Share of Age Cohorts of Multicultural Children



Note: This figure has been restructured by 2018 Analysis on the National Survey of Multicultural Families. The ratio of children's age was the highest among those aged between 9 and 11(45.8%) in elementary school, followed by those aged 12 and 14 (24.1%) in middle school, those aged 15 and 17 (16.4%), and those aged between 18 and 24 (13.8%). And total number of multicultural children in South Korea keep increasing and now stands at 122,212 in 2018.

3.2.2. Investment for Multicultural Children

According to human capital theory, children are seen as an important future human economic asset (Becker & Tomes, 1986). Consequently, proponents of this theory stress the importance of investment in children to then achieve a high rate of return in terms of economic outcomes.

Human development theory also emphasizes that the returns on the investment in children extends beyond mere economic outcomes, contributing to crucial non-cognitive aspects such as personality traits (Sen, 1999; Cunha, Heckman, & Schennach, 2010).

However, investment in children is heavily dependent on their parents' economic status. Therefore, depending on how parents maximize their utility when using their endowment, children's outcomes, including cognitive abilities, skill mastery, and future earnings, can vary significantly (Becker & Tomes, 1986; Conti & Heckman, 2014; Leibowitz, 1974).

However, when children expand their life boundary to society, parents' investment alone can be insufficient for holistic childhood development due to a number of intervening factors. For example, children belonging to low socioeconomic groups may face more constraints on their growth. Thus, human capital theory and human development theory are both useful for painting a clear picture of the complex and dynamic nature of the effects of the investment in children's capabilities in terms of social policy (Conti & Heckman, 2014).

The 'technology of capability formation', based on human development theory, has emphasized the dynamics of diverse investments to children from the school, government, and other environmental factors along with parents' investment (Cunha et al., 2010; Conti & Heckman, 2014). Especially, the government's inputs aimed to ensure that children are not excluded from various opportunities while covering the roles of other social institutions. Examples of such initiatives include educational support, financial vouchers, and even counseling and social participation (Ministry of Gender Equality and Family, 2018). This policy approach could potentially replace the lack of parents' endowment as well as the children's environment, which changes children's objective well-being (Bradshaw, 2015) and brings a positive effect on children's capabilities (Conti & Heckman, 2014).

In the case of multicultural children, the policy support is urgently needed. This is because multicultural children can face the disturbing factors for their development due to differences

in their inherited biological and cultural traits that cannot be solved by their parents' support alone in a certain region. If local attitudes to multiculturalism are distrustful or protectionist, multicultural children are more likely to perceive their inherited characteristics (including biological, cultural and ethnic characteristics) as disadvantages, likely hindering social assimilation, even if parents' investment in their education is sufficient. This situation is more likely to arise in countries with low past exposure to multiculturalism and cultural diversity, as well as those with a history of conservatism or isolationism, or both. Moreover, if immigrant parents themselves experience difficulties assimilating, economically and culturally, their children's life trajectories are even more likely to be negatively affected (Lee, 2018).

3.2.3. Multicultural Policy in South Korea

South Korea has been working to establish various legal approaches to help multicultural children since the Multicultural Families Support Act was enacted in 2008 (Multicultural Families Support Act, 2018). The Ministry of Gender Equality and Family oversees policies under this act, collaborating with the Ministry of Education, the Ministry of Culture, Sports and Tourism and other ministries, to establish a master plan for policies on multicultural families (hereafter Master Plan). The Master Plan is a nationwide policy framework that includes various services for multicultural families from each ministry, expected to be re-established every 5 years following 2010 (Multicultural Families Support Act, 2018). The initial Master Plan lasted from 2010 to 2012. The second and third Master Plan has currently being re-established every five years (2nd: 2013-2017; 3rd: 2018-2022).

The Master Plan includes services for multicultural children, which are divided into a school-based approach and an out-of-school approach. School-based services include Korean language education (known as KSL: Korean as a Second Language), academic support services (mentoring) and talent (skill) development.

KSL consists of special Korean language classes in elementary and middle schools with over ten multicultural students per school since 2012. Recently, this program has been expanded to include high schools. Schools with a smaller number of multicultural students provide KSL as optional after-school or weekend courses. Moreover, starting in 2018, students at schools without Korean language classes have been offered home-visiting services. This program can run from 6 months up to 2 semesters (almost 1 year). However, KSL is more likely to prioritize children born and partly raised in a foreign country that are now living in South Korea.

Regarding other types of in-school support, academic support has been conducted by the mentoring program since 2009 and reinforced following the Master Plan of 2010. In this program, the local education bureau selects the applicant among recommended university students and connects them with multicultural children. The selected university students are expected to act as mentors for multicultural children, helping with studying and homework as well as offering counseling. The Ministry of Education is largely in charge of this service, though the Ministry of Gender Equality and Family also provides similar programs including visiting multicultural families and helping children with schoolwork. Children are not able to receive both programs at the same time.

The talent (skill) development program targets multicultural children especially talented in art, physics, mathematics or science, aiming to develop their talent with help from the Ministry of education. Career development and bilingual language programs are also offered to the children to further enhance talent development.

Other types of financial support are also offered. These include after-school vouchers and lunch vouchers for school. Financial benefits are given to multicultural children in low-income families. Under the National Basic Living Security Act (2018), families with an income size of 50/100 of the standard median income can be eligible for such benefits. Furthermore, under the

Single-Parent Family Support Act (2018), children of an immigrated single parent, either due to the death of the South Korean spouse or divorce, also qualify for financial benefits. However, the magnitude of the financial benefits is constrained by budgetary limits, including admission fees, tuition fees, and school meal expenses (Elementary and Secondary Education Act, 2017).

The out-of-school approach is relatively more diverse. The Ministry of Gender Equality and Family operates multicultural family support centers and youth centers, both of which regularly organize cultural experience events, such as art museum and amusement park visits; they also establish counseling programs through the Community Youth Safety Net (CYS Net). In addition, a guideline has been set up to introduce a multicultural child quota, so as to guarantee multicultural children equal opportunities to participate in various social events.

With the exception of financial support, all the policy benefits outlined above have been provided to all multicultural children on a universal basis. In addition, multicultural policy has been expected to mitigate factors that negatively affect their development by supporting education and social opportunities for multicultural children (Ministry of Gender Equality and Family, 2016).

3.2.4. Children's Subjective Well-being

The expectation is that subjective well-being can predict children's objective well-being conditions in most countries (Bradshaw, 2015). Even though the validity of children's subjective well-being remains controversial due to children's susceptibility to transient changes in mood (Cummins, 2010), emerging evidence in support of the association between children's subjective and objective well-being is sufficient to counter this criticism. Bradshaw et al. (2013) demonstrated the extent to which aspects of macro-level objective well-being, such as material well-being, health and safety, education, behavior, housing and environment, explained children's subjective well-being in rich countries. Other studies regarding micro-level objective

well-being indicators also demonstrated its effect on children's subjective well-being. For instance, studies in the UK revealed how the quality of housing and environment, children's use of time and sufficient space were all important elements of an objective well-being context for children's overall well-being status (Bradshaw, 2016). Aspects of the socio-economic context, namely, whether children can have access to a computer and good quality clothes (Dinisman & Ben-Arieh, 2016), and other social opportunities (Park & Wang, 2018) were also discussed as explanatory variables for subjective well-being. Additionally, household income, including deprivation and intra-household income share, robustly demonstrates the variations in children's subjective well-being (Main, 2019)

However, previous studies on multicultural children's subjective well-being in South Korea have focused mostly on relationships and psychological status within the family and school contexts. An et al. (2013) illustrated how the influence of conflicts with parents contributed to the variations in the subjective well-being of elementary school students aged between 12 and 16. Foreign parents' acculturative stress and children's own stress levels have also been discussed in the literature as having a negative effect on children's subjective well-being (In, 2017; Kim & Yun, 2018). Other studies have also stressed that poor relationships with peers due to discrimination can lower the subjective well-being of children aged between 10 and 15 (Lee & Chung, 2016). Oh (2016) specifically found that bullying can even contribute to depression in multicultural children's self-esteem and self-resilience have also been discussed as crucial aspects of subjective well-being (An, Lee, & Lim, 2013; Park & Yang, 2017).

Currently, there is an increasing volume of studies analyzing the objective well-being of multicultural children and presenting policy suggestions. Thorough those studies are, it is evident that multicultural children face difficulties with schoolwork, lack of social participation, and the communication barrier with peers and with their foreign parent due to a linguistic and cultural mismatch, all of which can also be confounding factors in children's relationship and

psychological matters (Ministry of Gender Equality and Family, 2013, 2016, 2019; Lee & Chung, 2016; Yang & Ham, 2018).

In sum, these studies all emphasized that promoting a policy approach that can support children's subjective indicators, such as relationships with parents, peers, and teachers, and could be an important step towards increasing multicultural children's subjective well-being (An et al., 2013; Baek, Park, and Chung, 2018; Chun & Lee, 2015: Park and Yang, 2017). The contribution of policy to these expectations is evident in the presence of multiple policy programs aiming to reduce poverty, improve children's health, and provide more opportunities for education and other social activities, which have been shown to be strongly correlated with children's subjective well-being. Therefore, it is plausible to conclude that the effectiveness of policy in promoting objective well-being can be measured by changes in subjective well-being.

However, no studies have been conducted to evaluate multicultural children's subjective well-being in the context of policy analysis. In the case of the policy analysis conducted by Kim and Ko (2018), even though the programs with the highest participation rates and the support methods most favored by children were discussed in detail, the effectiveness of the policies remained unaddressed. Other studies dealing with policy effectiveness have similarly focused on the effects of educational support on academic achievement and school adaptation (Oh & Park, 2018; Park, Rhee, & Park, 2014). As of yet, research investigating policy effects as an important domain for multicultural children's subjective well-being has not been done.

3.2.5. Children's Subjective Well-being Measures

Subjective well-being is typically defined by three concepts: positive affect, negative affect and global life satisfaction (Diener, 1984; Diener, Scollon, & Lucas, 2003; Rees et al., 2013; Wang, 2015). Positive and negative affect both measure children's current emotional status, while global life satisfaction is a cognitive aspect reflecting children's evaluation of their own life as

a whole (Helliwell et al., 2012, 2016; Wang, 2015). However, Casas (2017) expressed concern that most psychometric studies on children's subjective well-being have utilized single-item scales, which underestimate the complexity of the subject. Thus, Casas (2017) used a multiple-item scale representative of various types of emotional status, to evaluate children under 12 years of age. Children ages 11 and up, however, tend to be evaluated using direct questions concerning overall life satisfaction (OECD, 2013). In this study the subjective well-being follows the direct questions about positive affect, negative affect and life satisfaction, since the samples are aged more than 11 year old.

3.3. Data and Methodology

The data used for this analysis is Multicultural Adolescent Panel Study (MAPS), collected by the Korea National Youth Policy Institute between 2011 and 2016. The first wave conducted on multicultural children and one of each child's parents in South Korea. The sample in the year 2011 was 1,635, which makes up around 36 percent of the total 4,452 multicultural students studying in 2,537 nationwide elementary schools. Thus, this data can be considered reliable and representative of multicultural children. Multicultural children during the first wave were aged between 9 and 13 and attending the 4^{th} grade; subsequently, they became 5^{th} graders in the second wave, and so on.

In this data, multicultural children are defined as any of the following: children born in South Korea from international marriages; children who were born abroad but subsequently immigrated to South Korea; children of foreign parents living in South Korea. However, as seen in <Table 3-1>, which reports parents' country of origin, the 94 percent of samples of multicultural children in the population are those born to couples in international marriages. Of the multicultural families formed via international marriage, 96 percent had a foreign mother, and 4 percent had a foreign father. The parents' countries of origin included the following:

China, Vietnam, the Philippines, Japan, Taiwan; a minority came from Cambodia, Uzbekistan, Russia, Indonesia, Kazakhstan, and Malaysia (Korea National Youth Policy Institution, 2018).

The baseline survey in the year 2011 contained questions regarding both past experience and current status. Concerning the second wave, the questionnaire aimed to determine if any answers had changed since the last survey. Children's policy benefits were identified through the parents' survey, and the parents who participated in the survey responded with either 'yes' or 'no' to the following question: 'has your child received any multicultural benefits since last year on the basis of being from a multicultural family, at school or any other institution?' The specific benefits children received were also recorded. However, in the first wave, the questionnaire lacked a question about policy benefits. Instead, in the second wave, parents received the following question: 'has your child received any multicultural benefits since last year (including the 4th grade) on the basis of your child's status as multicultural, at school or any other institution?' For this reason, the answer about policy from the second wave considered as an answer for both the first wave and the second wave.

<Table 3-1> Parents' Origin Country in MAPS (wave1, 2011)

Parents' Origin Country	Mother		Father	
	Freq.(N)	Percent (%)	Freq.(N)	Percent (%)
Korea	69	4.22	1,476	95.41
China	125	7.65	5	0.32
Ethnic Korean from China	323	19.76	1	0.06
Vietnam	42	2.57	2	0.13
Philippine	401	24.53	4	0.26
Japan	528	32.29	22	0.42
Taiwan	56	3.43	-	-
Others	91	5.57	37	2.39
Total(N)	1,635	100	1,547	100

Note: The 'others' in the category includes Cambodia, Uzbekistan, Russia, Indonesia, Kazakhstan, and Malaysia. North Korean is not collected in the sample.

In the year 2012, 993 children out of a total sample of 1,500 were recorded to have received

policy benefits. However, the number of children who received the benefits decreased as they transitioned to later grades. <Tables 3-2 and 3-3> report the types of benefits and the number of children who received them.

<Table 3-2> Benefits to Multicultural Children

Benefit	2011	2012	2013	2014	2015	2016
Yes	993	993	736	349	345	293
No	507	507	707	1,031	1,002	1,036
Missing	135	-	-	-	-	-
Total(N)	1,635	1,500	1,443	1,380	1,347	1,329

Note: This table reports whether they received the benefit in each year. 'Yes' represents the children who received the benefit. 'No' is not. The source is from Multicultural Adolescents Panel Survey from 2011-2016.

The benefits reported by parents in the survey were divided into 15 categories. In this study, the benefits were re-categorized as financial, extracurricular activity, skill support, counseling, education, language, and career development. Financial support includes after-school participation vouchers, school materials, and lunch vouchers. Extracurricular activity benefits attempt to provide diverse cultural experiences, including amusement park visits, movie performances, and musicals. Skill support initiatives include opportunities to learn art, music, and athletic skills that children demonstrate talent for. Educational support provides mentoring services and study support. Finally, counseling, language, and career development opportunities were also given to multicultural children.

According to <Table 3-3>, the benefits most frequently received in 2012 were extracurricular activities, closely followed by financial support, and then educational support. However, financial support became most popular form of benefit in 2013 and remained so until 2016.

<Table 3-3> The Details of Multicultural Benefits

Benefit	2012	2013	2014	2015	2016
Financial	603	405	211	167	177
Extracurricular	607	336	108	111	98
Skill support	144	82	28	24	22
Counseling	71	42	15	15	18
Education	400	227	89	101	71
Language	75	43	21	17	18
Career development	1	-	15	19	19

Note: The benefits that children received reported by one of children's parents. There were 15 different categories when parent answered within the survey. The answer is categorized into 7 different benefits in the <Table 3-3>.

<Tables 3-4 and 3-5> present descriptive statistics and summary statistics. The dependent variable, subjective well-being, includes three measures: positive affect, negative affect, and overall life evaluation, which is also called 'happiness' (Kim et al. 2006). The statement 'Life is joyful to me' measures positive affect; the statement 'I do not have any worries' represents negative affect and the statement 'I think my life is happy' denotes overall life evaluation, measuring the level of children's life satisfaction. For all of the above, participants were asked to rate their degree of agreement or disagreement with the statement on a four-point Likert scale: one meaning 'definitely no', two denoting 'probably no', three being 'probably yes', and four signifying 'definitely yes'. Negative affect was reverse coded for this analysis.

<Table 3-4> Descriptive Statistics

Variables		Definition	
Dependent variables	Positive affect	The life is joyful to me	1. Definitely not 2. Probably not 3. Probably yes 4. Definitely yes
	Negative affect	I don't have any worries	
	Life satisfaction	I think my life is happy	
Policy intervention	Multicultural children's benefit	Whether children get multicultural policy benefit since last survey	Dummy (1=get the benefit)
	Financial support	Lunch voucher, After school voucher, School material	Dummy (1=get the benefit)
	Program support	Extracurricular activities, Education, Counseling	Dummy (1=get the benefit)
Controls	Gender	Children's gender	1=Female, 0=Male
	Children Age	Children's age	# age
	Number of friends	How many close friends do you have?	# of close friends
	Income	Monthly income	10,000 won (Kor)
	Mother age	Mother's age	#age
	Father final education	1. Less than High school/ 2. 2-3 years education/ 3. 4 years university/4. Master or Ph.D.	Dummy for each category
	Mother final education	1. Less than High school/2. 2-3 years education 3. 4 years university/4. Master or Ph.D.	Dummy for each category
	Mother's Korean ability	The level of mother's Korean speaking	1. Completely not 2. Not good 3. Good 4. Very good
	Community	1. I know most people in my neighborhood 2. I greet people in my neighborhood on the street 3. Our neighbors are on the lookout for each other (reverse coded) 4. I feel safe in my neighborhood 5. I like to stay with my neighbor 6. I want to keep living in this area	Sum of 6 question each question answers 1. Definitely not 2. Probably not 3. Probably yes 4. Definitely yes
	Family support	1. My family seems to help each other a lot 2. My family seems to understand me well 3. My family shares well what they have 4. My family gives me strength and courage when I am having a hard time 5. My family seems to listen to my thoughts and words 6. My family seems to think of me as an important person 7. My family seems to think of me all the time	Sum of 7 question each question answers 1. Definitely not 2. Probably not 3. Probably yes 4. Definitely yes
	Teacher support	1. My teacher cares about me 2. If I am sick or something happens, my teacher helps me 3. My teacher regards me as an important person	Sum of 3 question 1. Definitely not 2. Probably not 3. May or may not 4. Probably yes 5. Definitely yes

<Table 3-5> Summary Statistics

	Variable	Obs.	Mean	Std. Dev.	Min	Max
Dependent variable	Positive affect	8,634	3.33	0.62	1	4
	Negative affect	8,634	2.01	0.79	1	4
	Life satisfaction	8,634	3.29	0.65	1	4
Policy intervention	Multicultural children's benefit	8,634	0.43	0.50	0	1
	Financial Support	8,634	0.18	0.39	0	1
	Program Support	8,634	0.24	0.43	0	1
Controls	Female	8,634	0.51	0.50	0	1
	Children's age	8,634	12.36	1.75	9	18
	Number of friends	8,633	8.89	8.13	0	134
	Income (monthly) unit. 10,000 won	8,566	232.8	117.6	0	2800
	log(1+income)	8,566	5.33	0.55	0	7.94
	Mother age	8,585	42.80	5.48	20	65
	Number of families	8,585	4.63	1.23	2	11
	Father education : High school	8,634	0.78	0.42	0	1
	Father education : 2-3yrs college	8,634	0.07	0.25	0	1
	Father education : 4 yrs. university	8,634	0.10	0.30	0	1
	Father education : Master or PhD	8,634	0.01	0.10	0	1
	Mother education : High school	8,634	0.58	0.49	0	1
	Mother education : 2-3yrs college	8,634	0.25	0.43	0	1
	Mother education : 4 yrs. university	8,634	0.16	0.37	0	1
	Mother education : Master or PhD	8,634	0.01	0.08	0	1
	Mother's Korean ability (speaking)	8,296	3.32	0.59	1	4
	Community	8,634	17.99	2.93	6	24
	Family support	8,634	22.38	3.95	7	28
	Teacher support	8,634	11.12	2.69	3	15

Note: The survey year is from 2011 to 2016. There are total 6 waves. The number of samples in each year is 1,635(2011), 1,500(2012), 1443(2013), 1380(2014), 1347(2015), and 1,329(2016).

Policy intervention was measured by a dummy variable determining whether they received the intervention or not. The number of benefit types was also considered for the additional analysis later. The effect of policy benefits on children's subjective well-being is estimated by the individual fixed effect. The main equation is below.

$$Y_{ict} = \alpha + \beta_1 Treat_{ict} + \beta_2 middle_{ict} + \beta_3 Treat_{ict} * middle_{ict}$$

$$+X'_{it}\gamma + \rho_i + \sigma_t + \mu_c + \varepsilon_{ict}$$

The dependent variable Y_{ict} represents the individual i′s self-reported subjective well-being, namely, positive affect, negative affect, and life satisfaction at the residential city c, and at the time t. $Treat_{ict}$ is a dummy variable to represent whether children received the benefit or not. $middle_i$ is also a dummy variable, which equals to one if the school period is middle school. Since children experience changes in the school curriculum and school environment when they move from elementary school to high school (Youm et al., 2018), the middle school dummy and its interaction term with treatment ($Treat_{ict} * middle_{ict}$) are included in the empirical model. X'_{it} is a time-variant individual characteristics. ρ_i is the individual fixed effect, σ_t is the year fixed effect, and μ_c is the residential area fixed effect. Lastly, ε_{ict} is an error term.

3.4. Results

3.4.1. The Effect of Multicultural Policy on Children's SWB

<Table 3-6> reports the effects of multicultural policy on children's subjective well-being using the individual fixed effect. The treatment dummy variable (Treat) indicates whether children received the policy benefit or not. The interaction dummy of Treat, and the school indicator (Middle) dummy have been included in the regression to compare the effects between elementary school (equal to zero) and middle school (equal to one). Columns (1) through (3) all included relevant controls indicated by previous studies, as well as fixed effects (individual, area, and year) to remove any time invariant characteristics. The dependent variables are the components of children's subjective well-being (positive, negative, and life satisfaction).

The estimate of 'Treat' in the first row reports that when other variables remain constant, children who received benefits during elementary school from 2011(4^{th} grade) to 2013(6^{th} grade) were more likely to report positive emotions and less likely to experience negative emotions within the conventional statistical significance. However, in the case of life satisfaction (LS) in column (3), the result was not statistically significant. Specifically, these results demonstrate

that children who received treatment during elementary school were likely to experience an increase of 0.05 (0.08 SDs) in positive affect, and a decrease of 0.081 (0.1 SDs) in negative affect. However, the significance direction (positive or negative) of the estimates changed when children were attending middle school. During middle school period itself (second row), the direction of subjective well-being is negative in positive affect and life satisfaction. In addition, the negative affect increased in column (2). These results confirm that subjective well-being trends downwards when children move to middle school. Moreover, exposure to the policy during middle school failed to improve the situation, tending to further reduce positive affect (0.12 SDs) and life satisfaction (0.12 SDs) while increasing negative affect (0.14 SDs) comparing to the effect during elementary school period.

<Table 3-6> The Effect of Multicultural Policy on Subjective Well-being

	(1) Positive	(2) Negative	(3) LS
Treat	0.050*	-0.081**	0.039
	(0.023)	(0.028)	(0.025)
Middle	-0.070*	0.273**	-0.100**
	(0.028)	(0.035)	(0.029)
Treat*Middle	-0.072*	0.110**	-0.075*
	(0.030)	(0.039)	(0.033)
Controls	Y	Y	Y
Individual FE	Y	Y	Y
Area FE	Y	Y	Y
Year FE	Y	Y	Y
_cons	2.617**	2.148**	2.392**
	(0.244)	(0.352)	(0.265)
N	8,237	8,237	8,237
N(id)	1,566	1,566	1,566
R-sq.	0.023	0.053	0.027

Note: Treat is a dummy variable, which equals to one if they received the policy benefit since the last survey reported by children's parents. Dependent variables are subjective well-being measured by positive affect, negative affect, and life satisfaction (LS). The coefficient for other control variables can be found in Appendix B. Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01

These changes in direction during the transition period from elementary to middle school, demonstrated in <Table 3-6>, are strongly related to the downward trend in program participation presented in <Table 3-2>. During elementary school, most children participated in program-based support. However, the participation rate fell steadily up until their middle school period. During middle school, the most popular benefit was financial support.

<Table 3-6> in Appendix B, which lists estimates of control variables, clearly demonstrates that the number of friends also affects children's subjective well-being, and in the generally expected direction (positive). This reinforces the results of previous studies, which demonstrated that the number of friends an individual has could be an important factor during the testing time between childhood and adolescence (An et al., 2013; Goswami, 2012; Hwang, Choi, & Lim, 2016). Furthermore, mothers' Korean language abilities (especially speaking) were also found to be strongly related to children's subjective well-being (in all three components). When mothers' self-reported Korean speaking skills increased by one unit, positive affect increased by 0.096 (0.15 SDs) and life satisfaction by 0.097(0.15 SDs). Conversely, negative affect in column (2) decreased by 0.062(0.08 SDs).

According to the Ministry of Gender Equality and Family (2019), multicultural children are more likely to share their problems with their mothers rather than their friends, when compared to their non-multicultural peers in South Korea (Ministry of Gender Equality and Family, 2019). In this case, the results demonstrated that children who cannot speak their mother's language or whose mother is unable to communicate effectively in Korean tend to be more vulnerable to life difficulties, which would negatively affect their level of subjective well-being. .

In sum, while children show an overall opposite direction in subjective well-being between elementary school and middle school, the policy benefits seem to have had a positive effect on childrens' emotional state during elementary school. The benefits also succeeded in reducing negative affect during the same period. On the other hand, the results indicate that the

experience of policy benefits is likely having a negative effect on children's subjective well-being in their middle school period.

In order to evaluate whether the specific type of policy benefits children received matters, the type of policy is dived by program-based support and financial-based support. <Table 3-7> analyzed the program-based support only; <Table 3-8> conducted the regression by financial-based support. Program-based support consists of extracurricular activities, educational programs, skill development, and counseling. Financial support represents after-school vouchers, lunch vouchers, and school materials. The policy benefit variable was defined as dummy variable of zero and one, 'one' indicating that children received the relevant program and 'zero' indicating that they did not receive the program.

The estimates from <Table 3-7> show that receiving benefits during elementary school has positive effect on all three components of subjective well-being. Additionally, not only did the estimate size increase, exceeding the main results, but life satisfaction in column (3) also increased to a statistically significant value, whereas it was statistically insignificant in the main result in <Table 3-6>. With other factors kept constant, the program support increased positive affect by 0.068 (0.11 SDs) and life satisfaction by 0.053 (0.082 SDs), and reduced negative affect by 0.104 (0.13 SDs). The effect of program support on subjective well-being during the middle school period, however, was negative. In the case of negative affect in the column (2), program support during middle school increased the negative affect by 0.19 SDs.

<Table 3-7> The Effect of Program-based Support on Subjective Well-being

	(1)	(2)	(3)
	Positive	Negative	LS
Program support	0.068**	-0.104**	0.053*
	(0.022)	(0.028)	(0.024)
Middle	-0.108**	0.326**	-0.130**
	(0.022)	(0.029)	(0.023)
Program support*Middle	-0.065*	0.150**	-0.072*
	(0.032)	(0.043)	(0.035)
Controls	Y	Y	Y
Individual FE	Y	Y	Y
Area FE	Y	Y	Y
Year FE	Y	Y	Y
_cons	2.650**	2.098**	2.415**
	(0.242)	(0.349)	(0.263)
N	8,237	8,237	8,237
N(id)	1,566	1,566	1,566
R-sq.	0.023	0.054	0.027

Note: Program support is dummy variable, which is equal to one if they received the policy benefit (program based; extracurricular activities, educational program, skill development, and counseling) since last survey reported by children's parents. Dependent variables are subjective well-being measured by positive affect, negative affect, and life satisfaction (LS). Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01

<Table 3-8> reports the effect of financial support (after-school vouchers, lunch vouchers and school materials) on children's subjective well-being. Officially, financial support is provided to children who are born to low-income families (at least 50/100 of the standard median income). Nevertheless, some of children in this data were found to have received financial support even though they did not meet the above criterion. In this regression, the association between financial support and both children's positive affect and life satisfaction was insignificant. However, negative affect during elementary school in column (2) significantly fell by 0.073 (0.09 SDs).

<Table 3-8> The Effect of Financial Support on Subjective Well-being

	(1) Positive	(2) Negative	(3) LS
Financial (Vouchers, Learning Materials)	0.032	-0.073*	-0.002
	(0.023)	(0.030)	(0.025)
Middle	-0.105**	0.334**	-0.130**
	(0.022)	(0.030)	(0.023)
Financial*Middle	-0.054	0.063	-0.022
	(0.035)	(0.044)	(0.038)
Controls	Y	Y	Y
Individual FE	Y	Y	Y
Area FE	Y	Y	Y
Year FE	Y	Y	Y
_cons	2.638**	2.123**	2.415**
	(0.243)	(0.351)	(0.264)
N	8,237	8,237	8,237
N(id)	1,566	1,566	1,566
R-sq.	0.022	0.052	0.027

Note: Financial support is dummy variable, which is equal to one if they received the policy benefit (financial based; After-school voucher, lunch voucher, and school materials) since last survey reported by children's parents. Dependent variables are subjective well-being measured by positive affect, negative affect, and life satisfaction (LS). Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01

3.4.2. Further Results

This section reports on further results that build on the main findings. First of all, it considers both the relevant covariates and the subjectively measured variables included in the model. Secondly, since the dependent variable uses a four-point Likert scale, a random effects-ordered logistic regression has been conducted separately for each year. In addition, the effects of policy benefits, differentiated by gender and foreign parents, as well as family income level are all considered to address any remaining omitted variable concerns.

A. Robustness Check.

<Table 3-9> includes relevant variables that have been measured via self-reported evaluation, such as community environment, family support and teacher support, all of which were proven to have positive effects on children's subjective well-being in previous studies in the field of psychology (Baek et al., 2018; Bradshaw, 2015; Chun & Lee, 2015: Park & Yang, 2017). The

results show the robust estimates of the results from <Table 3-6>. Even though the size of the estimates was slightly reduced compared to the main results, the significance level stayed the same. In addition, all newly included variables were statistically significant, increased children's positive aspects and life satisfaction, and reduced negative affect.

<Table 3-9> Robustness: Including Relevant Variables

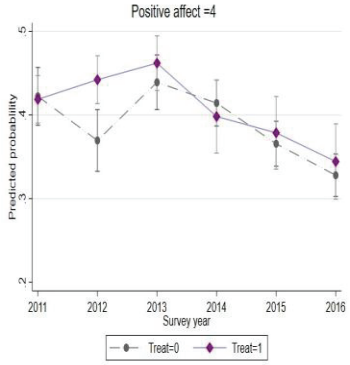
	(1) Positive	(2) Negative	(3) LS
Treat	0.044*	-0.076**	0.033
	(0.020)	(0.026)	(0.022)
Middle	-0.058*	0.250**	-0.084**
	(0.025)	(0.033)	(0.026)
Treat*Middle	-0.073**	0.112**	-0.076*
	(0.027)	(0.036)	(0.030)
Community environment	0.041**	-0.051**	0.044**
	(0.003)	(0.004)	(0.003)
Family Support	0.042**	-0.037**	0.044**
	(0.003)	(0.003)	(0.003)
Teacher Support	0.030**	-0.025**	0.029**
	(0.003)	(0.004)	(0.003)
Controls	Y	Y	Y
Individual FE	Y	Y	Y
Area FE	Y	Y	Y
Year FE	Y	Y	Y
_cons	0.907**	3.854**	0.603*
	(0.229)	(0.311)	(0.249)
N	8,237	8,237	8,237
N(id)	1,566	1,566	1,566
R-sq.	0.186	0.145	0.185

Note: Children's self-reported evaluation about community environment, family support, and teacher support are additionally included in the model. Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01

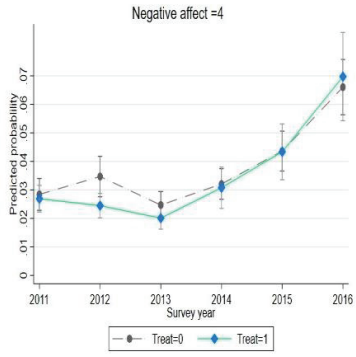
Subsequently, this paper conducted the logistic regression comparing the effect from each year in order to address the concern of categorical dependent variables. The result from the logistic regression is in Appendix C. <Figure 3-2> through <Figure 3-4> present the probabilities of the results from the logistic regression in Appendix C. <Figure 3-2> represents positive affect, indicating that children receiving policy benefits were more likely to have the highest positive affect during elementary school (year 2011-2013), which is measured by a

four-point Likert scale (4 meaning ‘definitely yes’ concerning positive affect, negative affect, and life satisfaction). Furthermore, there was a little number of differences depended on policy during the middle school period (year 2014-2016). <Figure 3-2> presents a similar trend: children who receive benefits are less likely to have the highest level of negative affect during the elementary school. The predicted probability for having the highest life satisfaction in <Figure 3-4> followed a similar pattern to positive affect in <Figure 3-2>. The overall graph shows a downward trend following the year 2013 in both positive affect and life satisfaction. Conversely, it shows an upward trend in negative affect.

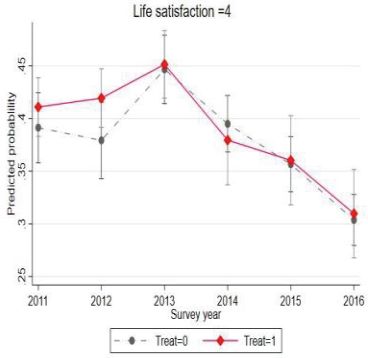
<Figure 3-2>
Positive Affect



<Figure 3-3>
Negative Affect



<Figure 3-4>
Life satisfaction



Note: Each figure illustrates the probability of being the highest level (4; when it measured 4 Likert scales) of each measure of subjective well-being; Positive Affect, Negative Affect, and Life Satisfaction. The logistic regression regarding those figures can be found in Appendix C.

B. Heterogeneous Effects

This section explores the effect of multicultural policy on children's subjective well-being differentiated by gender, foreign parent, school, and family income level. <Table 3-10> reports the effects by gender. Panel A presents the results on male children, and panel B represents female children. When the data was divided by gender, the effect on male children during elementary school remained constant, but the significance of the effect on female children in the same period disappeared. The drop in subjective well-being among male children during

middle school (third row) was the same as the main result in <Table 3-6>. However, the downward trend of subjective well-being during middle school (second row) in both positive affect and life satisfaction was statistically significant only in the female group.

<Table 3-10> The Effect of Multicultural Policy on Subjective Well-being by Gender

	Panel A. Male			Panel B. Female		
	(1)	(2)	(3)	(4)	(5)	(6)
	Positive	Negative	LS	Positive	Negative	LS
Treat	0.081*	-0.103**	0.066+	0.018	-0.058	0.008
	(0.032)	(0.038)	(0.033)	(0.033)	(0.042)	(0.036)
Middle	0.001	0.170**	-0.015	-0.140**	0.375**	-0.186**
	(0.038)	(0.047)	(0.041)	(0.039)	(0.052)	(0.041)
Treat*Middle	-0.108**	0.102+	-0.112*	-0.032	0.107+	-0.030
	(0.041)	(0.054)	(0.047)	(0.043)	(0.055)	(0.048)
Control	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y
Area FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
_cons	2.342**	2.939**	1.822**	2.833**	1.619**	2.975**
	(0.307)	(0.351)	(0.311)	(0.364)	(0.406)	(0.385)
N	4,049	4,049	4,049	4,188	4,188	4,188
	769	769	769	797	797	797
R-sq.	0.023	0.044	0.028	0.030	0.074	0.037

Note: Panel A is only male children and Panel B is Female. Treat is dummy variable; equals to one is if children received the benefit. Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01

<Table 3-11> shows how the effects of policy differ depending on whether the mother is the foreigner. In this data, only a small number of children have a foreign father. For this reason, the sample of children with a foreign father could not be analyzed within this empirical model. <Table 3-11> tried to remove the sample of children with a foreign father sample and run the regression with the sample with children born in international marriages between a foreign mother and Korean father. Since the sample size in <Table 3-11> differs from that in <Table 3-6> by only 23, the results were almost the same as the main result.

<Table 3-11> The Effect of Multicultural Policy on Children's SWB within the Families with Foreign mother

	(1) Positive	(2) Negative	(3) LS
Treat	0.050*	-0.083**	0.039
	(0.023)	(0.028)	(0.025)
Middle	-0.069*	0.272**	-0.099**
	(0.028)	(0.035)	(0.029)
Treat*Middle	-0.075*	0.114**	-0.077*
	(0.030)	(0.039)	(0.033)
N	8,214	8,214	8,214
N(id)	1,561	1,561	1,561
R-sq.	0.023	0.053	0.027

Note: The data is restricted to the family with foreign mother and Korean father. All the controls and fixed effects are included. Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01

<Table 3-12> rechecked the effects of each specific policy benefit type. The data was divided into elementary school and middle school periods. Panel A was conducted with financial-based support only; Panel B used program-based support. When considering the effect of a specific benefit type on each school period, both program in panel A and B are insignificant for middle school period. However both program on positive and negative affect was robust to the main result during elementary school, even though the significance level was reduced.

<Table 3-12> The Effect of Multicultural Policy by School (Elementary vs. Middle school)

	Elementary School			Middle School		
	(1)	(2)	(3)	(4)	(5)	(6)
	Positive	Negative	LS	Positive	Negative	LS
Panel A. Financial Support						
Financial support(Vouchers, Learning Materials)	0.045+	-0.069*	-0.007	-0.011	-0.042	-0.023
	(0.026)	(0.034)	(0.029)	(0.031)	(0.042)	(0.034)
N	4,375	4,375	4,375	3,862	3,862	3,862
N(id)	1,566	1,566	1,566	1,329	1,329	1,329
R-sq.	0.011	0.014	0.015	0.024	0.057	0.029
Panel B. Program Support						
Program support	0.053*	-0.075*	0.029	0.005	0.014	-0.006
	(0.025)	(0.032)	(0.027)	(0.028)	(0.039)	(0.029)
N	4,375	4,375	4,375	3,862	3,862	3,862
N(id)	1,566	1,566	1,566	1,329	1,329	1,329
R-sq.	0.012	0.014	0.016	0.024	0.057	0.029

Note: Each benefit (financial support, program-based support) is measured by school period; Elementary school is only for elementary school period and middle school is only for middle school period. Since the data is divided by school level, the middle school dummy and the interaction term are not included. The fixed effects (individual, area, and year) are included in the both panel A and B. Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01

Lastly, <Table 3-13> reviewed how the effect of each policy differed depending on children's household income level, comparing children in low-income families with those in high-income families. Low-income families are in the bottom 25 percent of monthly household income within this data set; high-income families make up the upper 25 percent. The results demonstrate the robustness of the results in <Tables 3-7 and 3-8>. When children in low-income family received financial-based support, their negative affect reduced by 0.13 (0.16 SDs). The significance level of program-based support in panel B, however, was found only in the high-income family group.

<Table 3-13> The Effect of Multicultural Policy by Household Income Level (Low income vs. High income)

	Low income family			High income family		
	(1)	(2)	(3)	(4)	(5)	(6)
	Positive	Negative	LS	Positive	Negative	LS
Panel A. Financial Support						
Financial (Vouchers, Learning Materials)	0.029	-0.130*	-0.002	0.089+	-0.107+	0.007
	(0.045)	(0.061)	(0.048)	(0.047)	(0.064)	(0.054)
Middle	-0.059	0.320**	-0.102*	-0.095*	0.354**	-0.198**
	(0.051)	(0.063)	(0.052)	(0.043)	(0.060)	(0.046)
Financial*Middle	-0.054	0.113	-0.009	-0.102	0.059	0.001
	(0.068)	(0.087)	(0.074)	(0.069)	(0.090)	(0.076)
N	2,363	2,363	2,363	2,562	2,562	2,562
N(id)	780	780	780	810	810	810
R-sq.	0.023	0.042	0.032	0.026	0.063	0.039
Panel B. Program Support						
Program support	-0.007	-0.068	-0.021	0.115*	-0.181**	0.082+
	(0.045)	(0.058)	(0.046)	(0.045)	(0.058)	(0.048)
Middle	-0.062	0.318**	-0.112*	-0.091*	0.341**	-0.187**
	(0.051)	(0.064)	(0.051)	(0.043)	(0.060)	(0.046)
Program support*Middle	-0.001	0.054	0.060	-0.148*	0.233*	-0.142*
	(0.065)	(0.085)	(0.069)	(0.067)	(0.094)	(0.072)
N	2,363	2,363	2,363	2,562	2,562	2,562
N(id)	780	780	780	810	810	810
R-sq.	0.023	0.040	0.032	0.028	0.067	0.042

Note: Low income family is bottom 25% of income level among this sample. And the high income family is upper 25%. Panel A is only compared the benefit of financial support and Panel B is for program based support. The fixed effects (individual, area, and year) are included in the both panel A and B. Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01

3.5. Conclusion

This study analyzed the effects of multicultural policy on multicultural children's subjective well-being (positive affect, negative affect, and life satisfaction). Using the Multicultural Children Panel Survey collected from 2011 to 2016, this study explored the effect of the policy using individual fixed effects. The key variable was the treatment dummy denoting whether children received the policy benefit or not. In addition, the interaction term of treatment and school period was included in the empirical model to distinguish the different effect between

elementary school and middle school. For additional analysis, the benefits were grouped into financial-based support and program-based support. Lastly, the effect differed by gender, school and household income level were measured in the heterogeneity test.

The results showed that policy benefits were effective during elementary school, increasing ‘positive affect’ by 0.08 standard deviations and reducing ‘negative affect’ by 0.1 standard deviations. However, ‘life satisfaction’ was not statistically significant. Conversely, subjective well-being of children in middle school decreased in comparison to their level of subjective well-being during elementary school. Policy benefits were found to worsen subjective well-being levels during middle school further.

In order to isolate the effects of specific types of policy, this paper categorized policies as either ‘program-based support’ or ‘financial-based support’. Program-based support was found to have a statistically significant, positive effect on life satisfaction during elementary school (0.082 SDs), alongside the robust results concerning both 'positive and negative affect' to the main results. However, in the case of financial-based support, the results were statistically significant only in the case of negative affect (0.09 SDs).

The effect of gender and income level on policy outcomes was also analyzed. In the case of gender, the policy was found to be effective for male children during elementary school. And the negative effect on subjective well-being during middle school was also significant only for the male. As for household income level, program-based support had a statistically significant effect in the high-income family group. Conversely, financial support during elementary school significantly reducing negative affect in the low-income family group. The effect of financial support was still significant in the high-income family within the 10% significance level.

However, there are a few limitations to be considered when interpreting the results. Even though the analysis determined whether children received policy benefits or not by asking a question (‘has your child received any multicultural benefits since last year, because your child

is from a multicultural family, at school or other institutions?'), the specific location where the program would have taken place was not reported in the data. Furthermore, the data on policy benefits does not explain either how many times children benefited from each program, nor the timing of the program. And children would get more support and program information if their school had well-structured supporting systems; school counselors and multicultural programs at the school. However, this information could not be captured in this data. Therefore, even though the individual characteristics are removed by individual fixed effect, the effect could have been underestimated. Therefore in further studies, the detailed program should be considered for evaluating children's subjective well-being. And the nationally representative data collection of MAPS need to include more information about school characteristics and children's socioeconomic status.

There were also other findings from this data. First, as children get older, participation in policy program tends to decrease in general. This trend is similar to the national trends found in nationwide youth studies in 2018. It showed that children clearly reduced participation in the extracurricular activities as they moved to middle school and high school (Lim, Moon, & Jung, 2018). According to interviews with middle school children (personal communication, June 11, 2019), different tasks comparing to elementary school are occurring in children during middle school, and in fact, the mobile games have been the easiest way to spend their spare time more than to participate in any social program.

Second, the majority of multicultural children that are born and raised in South Korea state that they are not particularly different from typical local children, and that they are uncomfortable with receiving special support (personal communication, June 11, 2019; Dworkin & Dworkin, 1999; Yang & Kim, 2017; Yoon, 2010). This shows that multicultural children may be reluctant to participate in programs classified as multicultural programs. Third, most mothers want multicultural children to be educated in the same manner as local teenagers,

so even if their parents are aware of the existence of multicultural programs, they may be opposed to their children's participation in these programs (personal communication, June 13, 2019; Yang & Kim, 2017).

Therefore, even though the results of the empirical analysis of the elementary school period demonstrate that policy programs have the potential to make a positive impact, multicultural children in middle school may not be interested in these policy programs due to the potential stigma of participating in programs targeting a specially classified group.

In sum, policies provided between 2011 and 2016 helped improve subjective well-being during elementary school, but not during middle school. Program participation during middle school also decreased significantly. Therefore, we can conclude that current policy program can be more suitable for elementary school students than for middle school students. Here we can bring the suggesting that we need to characterize multicultural policy programs by school grade and organize and provide them.

In addition, interviews with multicultural children in middle school and previous literature showed that they deemed the program to be unnecessary, or that they were afraid that participation in the program would result in them being singled out and discriminated against. It is important to consider whether multicultural policy, which aims to help multicultural children assimilate and avoid feelings of alienation from society, has the reverse effect of increasing the likelihood of discrimination by dividing multicultural children into specific categories and providing them with programs.

In particular, middle school students tend to value peer relations the most (Nickerson, Nagle, 2005). Thus, rather than categorizing multicultural children into vulnerable groups, it is more effective to provide them the tools to naturally improve their relationships with their peers by expanding the programs currently already in place for local children. Recently, multicultural education has been included in formal education, increasing the scope of the policy to help all

children become accustomed to multiculturalism through education. This can help strengthen peer-to-peer relationships and enhance mutual understanding by allowing multicultural children to be understood as a part of the group, not as a separate group. Access to universal services is expected to help multicultural children maintain their peer relationship skills and thus improve their consequent subjective well-being.

Appendix A. The Legal Definition of Multicultural Children & Juvenile

Law	Definition of Multicultural Children & Juvenile
Multicultural Families Support Act (2018)	Article 2(Definitions) 1. The terms used in this Act shall be defined as follows (a) A family comprised of immigrants by marriage defined in subparagraph 3 of Article 2 of the Framework Act on Treatment of Foreigners Residing in the Republic of Korea and persons who have acquired nationality of the Republic of Korea pursuant to Articles 2 through 4 of the Nationality Act; (b) A family comprised of a person who has acquired nationality of the Republic of Korea pursuant to Articles 3 and 4 of the Nationality Act and a person who has acquired nationality of the Republic of Korea pursuant to Articles 2 through 4 of the aforementioned Act; 2. The terms “immigrants by marriage, etc.” means any of the following persons; (a) Immigrants by marriage, etc. defined in subparagraph 3 of Article 2 of the Framework Act on Treatment of Foreigners Residing in the Republic of Korea (b) Persons who obtained permission for naturalization under Article 4 of the Nationality Act; 3. The term “Children and Juveniles” means persons aged 24 years or younger
Enforcement Decree of the Elementary and Secondary Education Act (2018)	Article 19 1. A Child or student who has returned to the Republic of Korea from a Foreign country 2. A Child or student, being a child of a Korean national residing abroad 3. A Child or student, being a North Korean refugee as defined in subparagraph 1 of Article 2 of the North Korean Refugees Protection and Settlement Support Act. 4. A foreign child or student 5. Other children or students who cannot take the procedures for admission or transfer under Articles 17 and 21 for the reason that he/she did not reside in the Republic of Korea before he/she is admitted or transferred to an elementary school, or has no school record in the Republic of Korea.
Youth Welfare Support Act (2017)	Article 18 (Support for Youth with immigrant Background) 1. Youth from any multicultural family defined in subparagraph 1 of Article 2 of Multicultural Families Support Act. 2. Other immigrant youth who experience difficulties in social adaptation and academic performance.
Framework Act on Treatment of Foreigners Residing in the Republic of Korea (2017)	Article 2 1.The term "foreigners in Korea" means those who do not possess the nationality of the Republic of Korea and who legally stay in Korea for the purpose of residing in Korea; 2.The term "treatment of foreigners in Korea" means the treatment of foreigners in Korea by the State and local governments according to their legal status; 3. The term "immigrant through marriage" means any foreigner in Korea who had or has a marital relationship with a Korean national.

Appendix B. The Effect of Multicultural Policy on Subjective Well-being (Table 3-6)

	(1) Positive	(2) Negative	(3) LS
Treat	0.050*	-0.081**	0.039
	(0.023)	(0.028)	(0.025)
Middle	-0.070*	0.273**	-0.100**
	(0.028)	(0.035)	(0.029)
Treat*Middle	-0.072*	0.110**	-0.075*
	(0.030)	(0.039)	(0.033)
Number of friends	0.003**	-0.003**	0.004**
	(0.001)	(0.001)	(0.001)
Log income(monthly)	-0.020	-0.001	0.011
	(0.022)	(0.026)	(0.022)
Number of families	0.053+	-0.048	0.062+
	(0.032)	(0.036)	(0.033)
Father education			
2yrs college	0.152	-0.476**	0.097
	(0.138)	(0.056)	(0.083)
4yrs university	-0.287	0.109	-0.317
	(0.348)	(0.093)	(0.356)
Mother education			
2yrs college	0.059	0.054	-0.102
	(0.117)	(0.169)	(0.289)
4yrs university	-0.017	0.899**	-0.196
	(0.116)	(0.169)	(0.289)
Master, PhD	-0.059	1.016**	-0.244
	(0.120)	(0.175)	(0.290)
Mother's Korean ability	0.096**	-0.062**	0.097**
	(0.015)	(0.020)	(0.016)
Individual FE	Y	Y	Y
Area FE	Y	Y	Y
Year FE	Y	Y	Y
_cons	2.617**	2.148**	2.392**
	(0.244)	(0.352)	(0.265)
N	8,237	8,237	8,237
N(id)	1,566	1,566	1,566
R-square	0.023	0.053	0.027

Note: Treat is dummy variable, which equals to one if they received the policy benefit since last survey reported by children's parents. Dependent variables are subjective well-being measured by positive affect, negative affect, and life satisfaction (LS). Robust standard errors are in parentheses. +p<0.10 *p<0.05 **p<0.01

Appendix C. Random Effects Ordered Logistic Models

	(1) Positive	(2) Negative	(3) LS
Treat*year2012	0.488**	-0.337*	0.150
	(0.174)	(0.155)	(0.169)
Treat*year2013	0.184	-0.195	-0.062
	(0.179)	(0.160)	(0.175)
Treat*year2014	-0.111	0.060	-0.235
	(0.196)	(0.176)	(0.192)
Treat*year2015	0.089	0.070	-0.095
	(0.197)	(0.176)	(0.193)
Treat*year2016	0.060	0.208	-0.139
	(0.202)	(0.181)	(0.197)
Treat	-0.053	-0.057	0.087
	(0.128)	(0.115)	(0.125)
Controls	Y	Y	Y
Cut1 _cons	-3.632**	-2.742**	-2.819**
	(0.436)	(0.375)	(0.422)
Cut2 _cons	-1.455**	0.152	-0.534
	(0.422)	(0.374)	(0.412)
Cut3 _cons	2.766**	2.697**	3.298**
	(0.422)	(0.378)	(0.414)
sigma2_u			
_cons	1.992**	1.513**	1.937**
	(0.134)	(0.099)	(0.128)
N	8237	8237	8237

Note: Robust standard errors are in parentheses. * p<0.05 ** p<0.01

References

An, S. J., Lee, H. C., & Lim, J. Y. (2013). The Influences of Conflict with Parents, Peer Relationship, and School Adaptation of Adolescents from Multicultural Families and their Satisfaction with Life : The Mediating Effects of Self-Esteem. *Journal of Korean Management Association, 31*(2), 77–91.

Baek, S. H., Park, S. Y., & Chung, H. W. (2018). Estimating the longitudinal changes in life satisfaction of multicultural adolescents via piecewise growth mixture modeling. *Korean Journal of Educational Research, 56*(1), 187–217.

Becker, G.S., and Tomes, N. (1986). Human Capital and Rise and fall of Families. *Journal of Labor Economics, 4*(3, Part2), S1-S39.

Ben-Arieh, A. (2007). *Measuring and monitoring the well-being of young children around the world*. Paris: UNESCO.

Bradshaw, J. (2015). Subjective well-being and social policy: Can nations make their children happier? *Child indicators research, 8*(1), 227-241.

Bradshaw, J. (Ed.). (2016). *The Well-being of Children in the UK*. Policy Press.

Bradshaw, J., Martorano, B., Natali, L., & de Neubourg, C. (2013). Children's Subjective Well-Being in Rich Countries. *Child Indicators Research, 6*(4), 619–635.

Casas, F. (2017). Analyzing the comparability of 3 multi-item subjective well-being psychometric scales among 15 countries using samples of 10 and 12-year-olds. *Child Indicators Research, 10*(2), 297-330.

Chun, H. Y., & Lee, M. R. (2015). Clustering of the Variables Related to the Life Satisfaction of Children from Multicultural Families - Focused on Personal, Family Environment, and School Life Factor. *Korea Journal of Child Care and Education, 95*, 1–24.

Conti, G., & Heckman, J. J. (2016). *Economics of child well-being* (pp. 363-401). Springer Netherlands.

Cunha, F., Heckman, J. J., & Schennach, S. (2010). Estimating the Technology of Cognitive and Noncognitive Skill Formation. *Econometrica, 78*(3), 883-931.

Dinisman, T., & Ben-Arieh, A. (2016). The characteristics of children's subjective well-being. *Social indicators research*, *126*(2), 555-569.

Diener, E. (1984). Subjective well-being. *Psychological Bullertin, 193*, 542-575.

Diener, E. Scollon, C. N. & Lucas, R. E. (2003). The evolving concept of subjective well-being; The multifaceted nature of happiness. *Advanced in Cell Aging and Geronrolgy, 13*, 187-219.

Dworkin, A. G., & Dworkin, R. J. (Eds.). (1999). *The minority report: An introduction to racial, ethnic, and gender relations*. Wadsworth Publishing Company.

Education statistics. (2018). Retrieved from http://std.kedi.re.kr

Evans, D. R. (1994). Enhancing quality of life in the population at large. *Social Indicators Research, 33*, 47–88.

Goswami, H. (2012). Social relationships and children's subjective well-being. *Social Indicators Research, 107*(3), 575-588.

Graber, J. A., Brooks-Gunn, J., & Petersen, A. C. (2018). *Adolescent transitions in context. In Transitions through adolescence* (pp. 369-383). Psychology Press.

Helliwell, J., Layard, R., & Sachs, J. (Eds.) (2012). *World Happiness Report 2012*. New York: Earth Institute, Columbia University.

Helliwell, J., Layard, R., & Sachs, J. (Eds.) (2016). *World Happiness Report 2016*, Update (Vol. I). New York: Sustainable Development Solutions Network.

Hwang, M. H., Choi, H. C., & Lim, H. J. (2016). A Longitudinal Relationship among Adolescents' Peer Attachment, Self-esteem, and Life Satisfcation. *Asian Journal of Education, 17*(3), 195-220.

In, H. Y. (2017). Longitudinal Relationships Among Adolescents Perceived Family Support, Life Satisfaction, and Mothers' Acculturative Stress in Multicultural Families. *Juornal of Youth Studies. 24*(10). 459-482.

Kim, A. (2018). Social Exclusion of Multicultural Families in Korea. *Social Sciences, 7*(4), 63.

Kim, K. Y., & Ko, E. S. (2018). A Study on the Perceptions and Factors of Immigrant Background Youth about Support Policy in Multi-cultural Education. *Journal of Educational Innovation Research, 28*, 405-425.

Kim, J. B., & Park, S. H. (2018). A study on school maladjustment of multicultural adolescents: Focusing on the longitudinal mediating effect of ego-resiliency. *Journal of School Social Work, 41*, 77–100.

Kim, M., & Yun, K. (2018). The Effects of Perceived Social Support on Life Satisfaction of Adolescents in Multicultural Familes; The Mediating Effects of Acculturative Stress and Ego-Resiliency. *Journal of the Korean Society for Wellness, 13*(1). 373-388.

Klock, A., Clair, A., & Bradshaw, J. (2014). International Variation in Child Subjective well-being. *Child Indicators Research, 7*(1). 1-20.

Korea National Youth Policy Institution. (2018). *Multicultural Adolescent Panel Study wave 1-6 data user's gude.* Sejong, Seoul: Korea National Youth Policy Institute.

Kim, S. Y., Lim, J. Y., Kim, S. W., Park, S. H., Yoo, S. Y., Choi, J. Y., & Shin, W. Y. (2006). *Korea youth development indicator I,* Seoul: National Youth Policy Institute.

Lee, S. B., & Cho, W. J. (2017). The Study of Physical Activity Habit for Academic Achievement, Stress Detection, Subjective Happiness and School Violence Experience in Multicultural Adolescents. *Journal of Holistic Convergence Education*. *21*(1). 79-94.

Lee, S.Y. (2018). A study of longitudinal changes and relevant factors of multicultural acceptability attitudes amongst multiethnic adolescents. *Studies on Korean Youth, 28*(1). 179-208.

Lee, J. Y., & Chung, G. (2016). The Influence of Discrimination and Coping Strategies on Life

Satisfaction of Multicultural Adolescents: The Moderating Effect of Coping Strategies. *Health and Social Welfare Review, 36*(3), 336–362.

Lee, R. H., & Chang, H. L. (2018). The influence of economic hardship on academic achievement and the mediating effect of happiness among multicultural adolescents. *Korea Institute of Youth Facility & Environment, 16*(4), 17-26.

Leibowitz, A. (1974). Home Investment in Children. *Journal of Political Economy, 82*(2), S111-S131.

Leung, C. Y. W., McBride-Chang, C. & Lai, B. P. Y. (2004). Relations among maternal parenting style, academic competence, and life satisfaction in Chinese early adolescents. *The Journal of Early Adolescence, 24*(2), 113-143.

Lim, H. J., Moon, H. Y., & Jung, J. H. (2018). *A Study on Youth Activity Survey V.* (Publication no. 18-R07). National Youth Policy Institute.

Main, G. (2019). Money matters: A nuanced approach to understanding the relationship between household income and child subjective well-being. *Child Indicators Research*, *12*(4), 1-21.

Ministry Gender Equality and Family (2013). *An Analysis on the National Survey of Multicultural Families 2012.* (Publication No. 2012-59). Retrieved from http://www.mogef.go.kr.

Ministry Gender Equality and Family (2016). *An Analysis on the National Survey of Multicultural Families 2015.* (Publication No. 2016-03). Retrieved from http://www.mogef.go.kr.

Ministry Gender Equality and Family (2019). *Summary of an Analysis on the National Survey of Multicultural Families 2018*. Retrieved from http://www.mogef.go.kr.

Ministry Gender Equality and Family (2018). *The 3rd Basic Plan for Multicultural Family Policy (2018-2022).* (Publication No. 11-1383000-000898-10). Retrieved from http://www.mogef.go.kr.

Nam, B. H., & Kim, K. J. (2018). A study on the experiences and perceptions of Korean-Chinese parents regarding the early culture adaptation of their immigrant children. *Studies on Korean Youth, 29*(2), 5–34.

Nickerson, A. B., & Nagle, R. J. (2005). Parent and peer attachment in late childhood and early adolescence. *The journal of early adolescence, 25*(2), 223-249.

OECD (2013). *OECD guidelines on measuring subjective well-being*, OECD Publishing. Retrieved from http://dx.doi.org/10.1787/9789264191655-en

Oh, S. B. & Park, H. H. (2018). Analysis of Gap in Regional gap Academic Achievement among Middle School Multicultural Students, *Journal of Education & Culture, 24*(2) 707-726.

Oh, S. H. (2016) The Study on the Eco-Systemic Variables Affecting Multicultural Family Adolescents' Depression. *The Korea Association of Community Welfare, 56*, 1-27.

Park, H. S., & Yang, S. H. (2017). The Growth Trajectory of Multiculutral Children's Life satisfaction in Korea. *Korean Education Inquiry, 35*(4).29-121.

Park. U. H. (2018). A Study on the Korean Multicultural Youth Education Support Services. *The Journal of Humanities and social Sciences 21*, 9(5), 1397-1411.

Park. J. H., & Nam, J. S. (2010). The Language Development and Psychosocial Adjustment of

Multicultural Children. *Studies on Korean Youth, 57*, 129-152.

Park, H. S., Rhee, C. W., & Park, S. E. (2014). Effectiveness of a Bilingual and Bicultural Education Program for School-aged Children from Multicultural Families-Mediating effects of the process outcomes. *Journal of the Korean Society of Child Welfare, 46*, 57-83.

Park, K. M., & Wang, S. (2018). Youth Activities and Children's Subjective Well-Being in Korea. *Journal of Happiness Studies*, 1-15.

Rees, G., Goswami, H., Pople, L., Bradshaw, J., Keung, A. and Main, G. (2013). *The Good Childhood Report 2013.* UK: The Children's Society.

Sen, A. (1999). *Development as Freedom*. New York: Random House.

Wang, S. (2015). *Measuring and explaining subjective well-being in Korea*, Seoul: Korea Development Institute.

Weber, M., Ruch, W., & Huebner, E. S. (2013). Adaptation and initial validation of the German version of the Students' Life Satisfaction Scale (German SLSS). *European Journal of Psychological Assessment, 29*, 105–112.

Yang, K. M., & Kim, J. Y. (2017). *A Study on Longitudinal Data for Multicultural Children and Policy V.* National Youth Policy Institute. No. 17-R12-2.

Youm, Y. S., Kim, K. M., Sung, Y. C., & Lee, S. W. (2018). *10th Korea Children Adolescent Happiness Index. Seoul: Korea Bhang Jeong Hwan Foundation*, Institute for Social Development Studies.

Yoon, I. J. (2010). Multicultural minority groups and multicultural coexistence in Korean society. *Korea Observer, 41*(4), 517-557.

Elementary and Secondary Education Act, Act no. 14603. (2017).

Enforcement Decree of the Elementary and Secondary Education Act, Presidential Decree no. 28112. (2017)

Framework Act on Treatment of Foreigners Residing in the Republic of Korea, Act no. 14974. (2017).

Framework Act on Youth, Act no. 15208 (2018).

Multicultural Families Support Act, Act no.15204. (2018).

National Basic Living Security Act, Act no. 15875. (2018).

Single-Parent Family Support Act, Act no. 15355. (2018).

Youth Welfare Support Act, Act no. 15210. (2017).