

초등학생의 우울증, 스마트폰 중독 및 학교생활 만족도의 관계에 대한 탐색: Partial Least Square(PLS) 경로모형 분석을 중심으로

주지혁*
극동대학교 언론홍보학과

Exploring relationships among Korean Children's Depression, Smartphone Addiction, and School Life Satisfaction: Focusing on Partial Least Square (PLS) Path Modeling

Jihyuk Joo*

Dept. of Journalism & Communication, Far East University*

요 약 스마트폰의 급격한 확산은 다양한 측면에서 부작용과 우려를 낳고 있다. 특히 초등학생의 스마트폰 중독 현상은 학부모나 선생님 등에 의해서 많은 관심을 끌고 있는 최근에 나타나고 있는 현상이다. 본 연구는 기존 연구검토를 통해 초등학생의 스마트폰 중독에 우울증이 영향을 미치고 우울증과 스마트폰 중독은 학교생활만족도에 영향을 미친다는 가정을 설정하고, 이를 Partial Least Square(PLS) 경로모형으로 검증하였다. 연구결과 우울증은 스마트폰 중독에 긍정적(+) 영향을 미쳤고 학교생활만족도에는 부정적(-) 영향을 미쳤다. 그리고 스마트폰 중독은 학교생활만족도에 부정적인(-) 영향을 미치는 것으로 나타났다. 따라서 어린이의 스마트폰 중독 예방과 학교생활만족도를 높이기 위해 우울 성향을 감소시킬 수 있는 가족과 학교 당국의 적절한 방안을 강구해야 한다.

주제어 : 초등학생, 우울증, 스마트폰 중독, 학교생활만족도, PLS 경로모형

Abstract The spread of smartphone in Korea causes several side effects and raises concerns. Especially, recently the addiction to smartphone of elementary school children has been paid attention to by their parents, teachers, and so on. After literature review, this research presented hypotheses that depression would affect children's addiction to smartphone positively and school life satisfaction (SLS) negatively, in turn their addiction to smartphone would affect SLS negatively. We employed Partial Least Square (PLS) path modeling to test the hypotheses. We found that all hypotheses were supported. The findings of this study suggest that their families and school authorities should make valid measures to lessen children's depression for preventing addicting to smartphone and, in turn, increasing SLS.

Key Words : elementary school children, depression, addiction to smartphone, school life satisfaction, PLS path modeling

Received 7 October 2013, Revised 2 November 2013
Accepted 20 December 2013
Corresponding Author: Jihyuk Joo (Far East University)
Email: hyukjoo@kdu.ac.kr

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ISSN: 1738-1916

1. Introduction

Addiction is an extreme phase of substance abuse and thus, it is defined as a set of compulsive dives into certain common activities or into the use of substance, in spite of all the severe individual consequences on a physical, spiritual, social, mental and financial level[1, 2]. The addictive behavior features escapism via the mental state. Addictions are sorted into two categories: chemical (pharmaceutical) and non-chemical. The chemical addition is not our present concern and we limit the discussion to non-chemical because present study focuses on the smartphone addiction of Korean children. The non-chemical, known as 'impulse control disorders', comprises gambling, kleptomania, pyromania, emotional addictions (sexual addictions), workaholism, compulsive money, and so on[1]. The smartphone addiction is a typical example of non-chemical.

Today, most of the children are born and brought up in circumstance surrounding many electronic devices like TV, cellphone, and so on. The circumstance makes child have pleasure and learn around world. Even though electronic devices have benefits for child, malfunctions are not a little also. One of them is the addiction to electronic devices. Especially child's addiction to smartphone recently attracts attention.

At schools in Korea, students entrust cell phones, including smartphones, to their teacher immediately on attending school and the cell phones are returned when they go home. Because many school authorities think cellular phone prevent student from studying, the action is taken at almost every schools. Not only hindrance of study but student's addiction to cell phone also is paid attention to by their teacher, parents, and so on. Recently child's addiction to smartphone emerges as a matter of concern. A kid newspaper reported, citing Seoul Metropolitan Office of Education's survey, that about 1% of elementary school student is over-user of smartphone. The report also covered internet over-user decreased but smartphone

over-user rose from a year ago[3]. The report predicted the addiction to smartphone among children is getting serious. According to another research[4], high-risk group of smartphone addiction was 2.2% and at-risk group 9.3% for child, whereas high-risk group was 1.0% and at-risk group 6.7% for adult. Child is more serious addicted to smartphone than adult.

Through children's using smartphone, they should undergo following changes of their brain. First, the development of brain stops. The brain of children addicted to smartphone is in stopping for a half of year. With accumulating of brain stop, children addicted to smartphone are worlds apart from non-addicted in development of brain. Second, with continuous use of smartphone, brain area controlling emotion should collapse. Thus their ability to perceive other's feeling, communicate with other, and control self-emotion should decline. In turn, their patience is getting falling and their unexpected action is getting frequent. After all, they may commit immorality or the so-called 'don't-ask, just-go' murder when they become adult[5].

With spreading smartphone into diverse user and over-using it, the concern with smartphone addiction has been growing. Several studies have been made on smartphone addiction of adults, college student or youth, but few attempts have been made at children's smartphone addiction in Korea. This research explores structural causalities among depression, addiction to smartphone, and school life satisfaction of Korean children. This study aims to overcome insufficiency of research on children's addiction, to present a significant suggestion to prevent smartphone addiction of children and to legitimate hindrance of carrying a smartphone in the school.

2. Literature Review and Hypotheses

2.1 Smartphone Addiction

As mentioned above, the addiction to smartphone is

a non-chemical and a latest phenomenon of electronic device addictions. The characteristics of smartphone make people addictive easily. So called 'hand-held computer', the diverse functions of smartphone, such as mobile working, banking, internet, and so on, make people's life more convenient but should lead people to be addictive. A staff of Youth Media Addiction Prevention Center said smartphone with all functions of previous media did not need space for hardware and exceptional mobility makes user more addictive[6].

In a survey of 612 members of smartphone community site by the press, 44% of smartphone users answered they seemed to be addicted to smartphone for themselves[6, 7]. A similar trend appeared in America. In a survey of 200 Stanford university students in 2010, only 6% of respondents were not addicted at all, 10% full addicted, 34% near-addicted, and among those who did not consider themselves completely addicted, 32% presented worry that they would become addicted someday[8].

In Korea, very few attempts have been made at children's addiction to smartphone. However, previous researches on cellular phone addiction provide insight on children's smartphone addiction. Yang and Park [9] classified five influences on cellular phone addiction: First, students' motives for using cellular phone; Second, depressive tendency; Third, using the phone for more than 3 hours per a day; Fourth, impulsive tendency; Fifth, consulting an expert. The authors insisted that the influences made student addict to the phone. Jang and Chae [10] identified adolescent addicted to cellular phone had low self-concept and dependent attachment to peer group, suffered from anxiety, and had low self-control and high impulsivity.

2.2 Depression, Addiction to Smartphone, and School life Satisfaction

This research reviews previous literatures and explores relationships among Korean children's

smartphone addiction, depression, and School life satisfaction (hereafter SLS).

The first is literature review on addiction to smartphone and depression.

Depression is diagnosed as a condition of psychological maladjustment to daily life[11]. Depression consists of three dimensions: depressed mood, depressive syndromes, and depressive disorders. Firstly, the depressed mood is concerned with depression as a symptom and refers to the presence of sadness, unhappiness, or blue feelings for an unspecified period of time. Secondly, depressive syndromes are concerned with depression as a constellation of behaviors and emotions. Lastly, depressive disorders refer to depression as psychiatric disorder[12]. Depression is the most frequent emotion in modern life that is very complicate, harshly competitive, and crudely materialistic. It ranges from the light depression which a normal people experiences with a routine stress event to psychopathological depression that is getting serious and is continuing symptoms for a long time[13].

Factually, there are few previous studies on relationship between depression and addiction to smartphone. Thus, literatures on relationship between addiction to mobile phone and depression may present insights to current study. The following is literature review on relationship between two constructs.

The study of 325 high school student in Seoul and Metropolitan area reported the group of addiction to cellular phone had lower self-esteem, higher depression and impulsivity than non-addictive group[14]. Another research of 300 middle and high school student in Daejeon Metropolitan City and North Chungcheong Province, Korea verified that the addictive using group of mobile phone was lower self-esteem and higher depression than non-addictive using group[15]. According to examining 284 elementary school student in Gyeonggi Province, Korea, it turned out that a significant variable to predict the addiction to cellular

phone is depression[16]. A study of age of 12 to 40 using mobile phone[17] reported significant predicting variables of the addictive mobile phone use were depression, personal expenses, recreational reason, imitation, sending frequency of text message, age, instrumental reason income, number of friends, and passive strategies for stress variables. Especially, depression was the most influential for predicting the addictive mobile phone use. It was found from above researches that more depressive adolescents were, more addicted to cellular phone they were. Thus, this study assumes that child using smartphone addictively has something to do with depression. Based on the assumption, hypothesis 1 is put forward:

H 1: Children's depression will have a positive effect on addiction to smartphone.

School life satisfaction refers to a subjective and cognitive assessment of general satisfaction with student's school experience [18-20]. SLS depends on the question how well student adapts to school life. SLS is also the state that students' appetite is satisfied with reasonable method for curricular activities, club activities, and so on and, while they are in harmony with their peers and teachers [21].

According to Kim and Kim [20], it is closely related to students' perception toward their quality of school life[22] and consciousness of an important component of their life satisfaction[23]. Thus, SLS is important in terms of students' psychological well-being and quality of life. SLS is the most representing terminology of students' school life well-being such as attachment to school, school belonging, school contentment, and liking for school[20]. Due to employing various aspects of school life together[24], most researches use SLS to represent the general satisfaction with school life, but not satisfaction with social relations in school[18, 25, 26].

Lee and Oak [27] showed that depression was negative predictor of adolescents' school adjustment in

Korea, a similar concept with **SLS**. Similarly, current research assumes that depression will influence negatively on **SLS**. Accordingly we hypothesise:

H2: Children's depression will have a negative effect on SLS

2.3 Addiction to smartphone and School life satisfaction

SLS is a friendly (or a hostile) emotion toward school life and has a direct effect on attitude toward school. Once the attitude is built, it cannot be changed easily. The elementary school life satisfaction of child decides SLS in the next decades. If an elementary school student gets negative feeling to teachers and classmates, he or she will hate to go to school and even refuse to attend classes. In turn, that may cause serious problem of his or her social life since then. Meanwhile, if child adapts to and is satisfied with elementary school life, it will have a positive effect on his or her general development and meaningful quality of life after that time[21]. Thus, research on children's SLS is very important. This research defines SLS as elementary school students' positive feeling and attitude toward their school life when they have relations with their teachers and friends.

In fact, there are a few researches on relation between SLS and addiction to cellular phone or smartphone in Korea. Hwang[28] reported group with addiction to cellular phone showed lower adjustment to school life than non-addicted group through the analysis of 511 middle school students in Changwon, Southern Kyeongsang Province, Korea, which signified that higher cellular phone addiction resulted in deteriorating school adjustment. Choi, Lee and Ha[29] identified that smartphone addiction affected university students' campus life, more precisely, higher addiction to smartphone made their campus life more disturbed through the survey of 227 Korean university students.

Thus, this study assumes that child using smartphone addictively has something to do with SLS. Based on the assumption, this study proposes that:

H 3: Children's addiction to smartphone will have a negative effect on SLS.

3. Method

3.1 Survey administration and Sample

To examine the hypotheses, the current research employed a self-reported survey of Korean children who use the smartphone. The survey was administered at two elementary school of a city in the Metropolitan area for two weeks from November 26 to December 7, 2012. Considering research purpose, the smartphone users were chosen intentionally through the school authorities' aid. That is, present study employed purposive sampling method.

Respondents chosen for this study were 250, whose demographic profiles are present in Table 1. As Table 1 appears, 52% of the respondents were male with 48% female. As for age composition, 33.6% of the respondents were 12 years old and 66.4% were 13 years old. In terms of school grade, 33.5% of respondents were 5th grade and 66.4% were 6th grade.

〈Table 1〉 Demographic profile

Demographic	N	Percentage
Sex	Male	52.0
	Female	48.0
Age	12	33.6
	13	66.4
Grade	5th	33.6
	6th	66.4

3.2 Measurement

The present study explores structural relationships among Korean children's depression, smartphone

addiction, and school life satisfaction. The research instruments consist of 4 parts questionnaire that were modified from a variety of sources to gather information regarding demographics, depression, addiction to smartphone, and school life satisfaction.

The items of *depression* are selected from the previous study that employed K-BDI(Beck Depression Inventory I- Korean version), modifying BDI[30] in Korean by Rhee, et al. [31]. K-BDI consists of 21items including sadness, pessimism, failure, dissatisfaction, and so on. K-BDI consisted of questions about how the respondent has been feeling in the last week. Each question has a set of at least four possible answer choices, ranging in intensity. For instance, the following statements measure sadness: (0) I do not feel sad, (1) I feel sad, (2) I am sad all the time and I cannot snap out of it, (3) I am so sad or unhappy that I cannot stand it.

When the test is scored, a value of 0 to 3 is assigned for each answer and then the total score is compared to a key to determine the depression's severity. Higher scored, more depressive.

Rhee, et al. [31] extracted 4 factors from 21 K-BDI items through iterating principal axis factoring : (i) guilty and self-dislike, (ii) negative self-image and psychomotor retardation, (iii) somatic aspect, and (iv) emotional expression and negative cognition. For structural equation modeling, 21 items of K-BDI are reduced and parceled into four variables, above four factor of Rhee, et al. [31]. First, 'guilty and self-dislike' includes self-dislike, guilt, failure, suicidal, sadness, punishment, and self-accusation. Second, 'negative self-image and psychomotor retardation' comprises work inhibition, indecisiveness, self-image, withdrawal, and libido loss. Third, 'somatic aspect' contains anorexia (appetite loss), insomnia, hypochondria, fatigue, and weight loss. The last, 'emotional expression and negative cognition' is irritability, crying, dissatisfaction, and pessimism. For partial least square (PLS) path modeling, present study need to reduce

21items of K-BDI, that is to say, combine items into parcels for confirmatory factor analysis (CFA). Item parceling aims to reduce the number of indicators of lengthy scales and surveys in CFA analyses and significantly improve fit of the CFA model in many conditions[32, 33]. Current study parcels items into factors of Rhee, et al. [31]. Individual items of the 4 factors sum into a parcel that is put in as indicators of *depression* when CFA is analyzed.

The items of *addiction to smartphone* are borrowed from Korean Smartphone Addiction Proneness Scale (hereafter KSAPS) for Youth [4] that was developed based on the existing internet addiction scales and cellular phone addiction scales. KSAPS for Youth consists of 15items dividing into four subdomains: (i) disturbance of adaptive functions, (ii) virtual life orientation, (iii) withdrawal, and (iv) tolerance. The disturbance of adaptive functions consists of five items, including 'My school grades dropped due to excessive smartphone use,' 'My smartphone does not distract me from my studies (reverse coded),' and so on. The virtual life orientation is measured with two items: 'Using a smartphone is more enjoyable than spending time with family or friends,' and 'When I cannot use a smartphone, I feel like I have lost the entire world.' The withdrawal comprises four items, including 'It would be painful if I am not allowed to use a smartphone,' 'I am not anxious even when I am without a smartphone (reverse coded),' and so forth. The tolerance is measured with four items, including 'I try cutting my smartphone usage time, but I fail,' 'I can control my smartphone use time (reverse coded),' and so on. Four-point Likert scales, ranged from strongly disagree (1) to strongly agree (4), were used to measure the items of KSAPS for Youth.

In the same way above constructs, current study makes the 15 items of KSAPS for Youth parcel into aforesaid four subdomains. Individual items of the four subdomains sum into a parcel to input as indicators of

addiction to smartphone for CFA analyzing. Higher scored, higher addictive, also.

Finally, the items of *SLS* are derived from Lee [34]'s scales. The *SLS* items comprise 36 items dividing into six subdomains: (i) overall feeling about school life, (ii) overall feeling about lessons, (iii) feeling about my teacher, (iv) feeling about relationship with classmates, (v) feeling about physical circumstances in school, and (vi) feeling about events in school. The overall feeling about school life has six items, including 'My school life is happy.' 'I get bored of spending time in school. (reverse coded)' and so on. The overall feeling about lessons is measured with six items, for examples 'Lessons are happy and unburdened.' 'I frequently pass no to understand lessons (reverse coded).' and so forth. The feeling about my teacher consists of six items, including 'When I meet my teacher on the street, I run to her or him and say hello.' 'I feel my teacher treats me kindly.' and so on. The feeling about relationship with classmates is measured with four items aside from 'I am satisfied to belong to my class.' and 'I want to transfer to another school (reverse coded).' The feeling about physical circumstances in school has four items excluding 'My classroom has the good circumstances and facilities to study.' and 'I feel uncomfortable with circumstances and structure of my classroom.' Finally, the feeling about events in school has six items, including 'I am happy to attend extracurricular activities.' 'There are many useless events in school (reverse coded).' and so forth. Five-point Likert scales, assigned from strongly disagree (1) to strongly agree (5), were employed to measure the items of *SLS*.

Just like the previous constructs, the 36 items of *SLS* were parceled into the aforementioned six subdomains. The individual items of the six subdomains sum into a parcel for inputting as indicators of SLS for CFA analyzing. Higher scored, greater satisfied.

As mentioned above, this research administers item

(Table 2) Descriptive statistics of parcels

Constructs	Parcels	Min	Max	Mean	S.D.
Depression	guilty & self-dislike (dprs1)	.00	16.00	1.84	2.69
	negative self-image & psychomotor retardation (dprs2)	.00	8.00	1.41	1.76
	somatic aspect (dprs3)	.00	7.00	1.27	1.34
	emotional expression & negative cognition (dprs4)	.00	9.00	1.80	1.70
Addiction to smartphone	disturbance of adaptive functions (adct1)	5.00	20.00	9.70	3.24
	virtual life orientation (adct2)	2.00	8.00	4.42	1.32
	withdrawal (adct3)	4.00	16.00	7.37	1.84
	tolerance (adct4)	5.00	17.00	7.96	2.02
School life satisfaction	feeling about school life (sls1)	6.00	30.00	20.65	3.45
	feeling about lesson (sls2)	9.00	26.00	19.05	3.10
	feeling about teacher (sls3)	10.00	30.00	20.12	3.70
	feeling about classmate (sls4)	6.00	30.00	20.93	3.91
	feeling about circumstance in school (sls5)	6.00	30.00	16.56	3.58
	feeling about school event (sls6)	6.00	30.00	19.56	3.48

parceling based on subdomains of constructs, which aims to reduce measurement items to analyze CFA and PLS path modeling. The following is outcome of item parceling. Table 2 shows descriptive statistics of the individual parcels of constructs which input as indicators of latent constructs for CFA and PLS path modeling.

3.3 Data Analysis

Current study employed PLS path modeling to test structural causalities among the four underlying constructs: depression, addiction to smartphone, and school life satisfaction. According to Gefen and Straub [35], PLS merges a factor analysis with multiple linear regressions to estimate the parameters of the measurement model (item loadings on constructs) together with those of the structural model (regression paths among the constructs) by minimizing residual variance[35]. PLS makes researchers examine validity of discriminant and convergent of scales which is important when we test a new model.

This study selected PLS method due to good advantages compared to covariance-based structural equation modeling (SEM) approaches like LISREL and AMOS[36, 37]. Whereas SEM emphasizes the sample

size, PLS is free from it, which PLS is good for a small sample size research [36–38]. Gefen, et al. [38] and Chin [39] presented that the minimum sample size in PLS path modeling need to be 10 times the number of items related to the most complex variable or constructs. Moreover, PLS is a suited tool for exploratory research [35–37, 39] like present study due to the availability of PLS to test new model and theory[38].

The addiction to smartphone is the latest issue and lacks a strong theory base, so that this study employed PLS method. Moreover, sample size of this research is small comparatively and 250 that satisfies criterion, i.e., 10 times the number of items of the most complex variable. The most complex variable is anxiety-present, comprised original 14items before parceling items. Thus, 250 samples are appropriate to the criterion due to needing more than 140 samples for this study.

4. Findings

4.1 Reliability and Validity of Measurement Scales

To examine reliability and validity of measurement scales, this study executes PLS Algorithm on Calculate

tap of SmartPLS 2.0 M3[40] package to get Cronbach's Alpha(α) and composite reliability.

Table 3 shows findings of CFA. In Table 3, composite reliability is greater than minimum criterion, 0.7, therefore the reliability of measurement scales is appropriate for analysis. Moreover the Cronbach's α of constructs are more than 0.6, the minimum criterion, and indicates reliable values.

〈Table 3〉 PLS quality criteria overview

	AVE	Composite Reliability	R Square	Cronbach's Alpha
Addiction to Smartphone	0.65	0.88	0.08	0.82
Depression	0.64	0.88		0.81
School Life Satisfaction	0.69	0.93	0.22	0.91

To test construct validity of measurement model, this research uses convergent and discriminant validity[41]. For examining convergent validity, this research considers AVE (Average Variance Extracted), of which the greater than 0.50 is valid convergent validity[35, 42]. According to Table 3, AVE in all constructs is greater than 0.5 and we accept that current research achieves the criterion.

To examine discriminant validity compares the inter-correlations within latent constructs with the root square of AVE of latent constructs. If the square root of AVE of each construct is greater than its correlations with the other latent constructs, the

discriminant validity is significant. Table 4 shows that the square root of AVE of construct is appropriate to the criterion respectively.

〈Table 4〉 Latent construct correlations

	Addiction to Smartphone	Depression	School Life Satisfaction
Addiction to Smartphone	(0.81)		
Depression	0.29	(0.80)	
School Life Satisfaction	-0.31	-0.43	(0.83)

Parentheses show square root of AVE

4.2 Test of Structural Model

The findings of hypotheses test and path coefficients of the proposed research model appear in Table 5. In PLS path modeling, the model validity is appraised by R square value and the structural paths[43]. This research executed bootstrapping to estimate the statistical significance of constructs path coefficient by means of t-tests. All three hypotheses are supported by the data. Depression predicts addiction to smartphone positively ($\beta=0.29$, $t=2.41$, $p<0.01$ one-tailed test), resulting in an R^2 of 0.085. Therefore, depression explained 8.5% of the variance in addiction to smartphone. SLS is predicted negatively by depression ($\beta=-0.37$, $t=3.95$, $p<0.001$, one-tailed test) and addiction to smartphone($\beta=-0.20$, $t=1.92$, $p<0.05$, one-tailed test) and the two constructs together explained 22.0% of the variance in SLS. The findings mean that as

〈Table 5〉 Hypotheses testing results

Hypotheses	Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (O/STERR)	Results
H1	Depression → Addiction to Smartphone	0.29	0.31	0.12	0.12	2.41	Supported (one-tailed test)
H2	Depression → School Life Satisfaction	-0.37	-0.38	0.09	0.09	3.95	Supported (one-tailed test)
H3	Addiction to Smartphone → School Life Satisfaction	-0.20	-0.21	0.10	0.10	1.92	Supported (one-tailed test)

hypothesized, addiction to smartphone is affected positively by depression and SLS is affected negatively by depression and addiction to smartphone.

5. Discussion and Conclusion

The smartphone addiction has been paid attention recently and is a typical addiction of non-chemical. Especially smartphone addiction of children has attracted the attention of their parents, teachers, and so on. Prevention of addiction to smartphone of children seems to be a social issue as well as an individual in Korea. However, there are few of study on children's smartphone addiction in Korea. This research aims to bridge a gap between practice and theory.

Current study employed PLS path modeling method to explore structural causalities among depression, addiction to smartphone, and school life satisfaction. We proposed and tested hypotheses which depression could predict SLS directly and indirectly, mediated by addiction to smartphone. This research found that depression predicted SLS negatively and smartphone addiction positively, in turn, smartphone addiction predicted SLS negatively. These findings lead us to the conclusion that children with more depressive tendency indulge in and are more readily addicted to smartphone. Furthermore, stronger depressive and addictive toward smartphone, children are lower satisfied with their school life. The findings are similar to aforementioned research that examined relations between depression and addiction to cellular phone[15-17], depression and school life adjustment[27], and addiction to cellular phone and school life adjustment[28, 29].

The findings of this study suggest that children's family and school authorities may make valid actions so that children cannot fall in depression, on the grounds that the depression influenced smartphone addiction and SLS. Thus, Korean educational scene needs to devise measures to lessen extremely

competitive and entrance-centered mood that may result in negative sentiment like depression of children. Furthermore, except for decreasing depression, various aspects of measures to prevent addiction to smartphone also will be considered due to harmful side effects caused by over-using smartphone.

Although this study provides significant implications for phenomena related to smartphone addiction, some limitations are inherent in current study. This research employed multi-items scales and made parcels with subdomain of original scales. To make measurement and analysis easier, future study should develop abbreviated scales with validity and reliability. In present study, moreover, addiction to smartphone merely was predicted by depression. The following works should consider psychological and social factors[see 15, 17] that influence smartphone addiction.

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주지혁(Joo, Jihyuk)



- 1996년 2월 : 한양대학교 신문방송학과(문학사)
- 1998년 2월 : 한양대학교 신문방송학과(문학석사)
- 2003년 2월 : 한양대학교 신문방송학과(문학박사, 언론학전공)
- 2003년 3월 ~ 현재 : 극동대학교 언론홍보학과 교수

- 관심분야 : 뉴미디어, 수용자
- E-Mail : hyukjoo@kdu.ac.kr