The Mediating Effect of Self-Esteem on the Relationship Between Smartphone Dependency and Academic Helplessness of Adolescents According to the Smartphone Dependence REGULATION

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Abstract

Purpose: This study tried to verify the mediating effect of self-esteem in the effects of smartphone dependence among adolescents on academic helplessness.

Method: 2,404 first-year middle school students were selected as research subjects using data form the second year of the Korea Children and Youth Panel Survey 2018. For the analysis method, the mediating effect was analyzed using the PROCESS macro 3.5(Model 4) suggested by Hayes(2017).

Results: Results of the study First, there was a significant positive relationship and influence between smartphone dependence and academic helplessness of adolescents, Second, a significant negative relationship and influence between smartphone dependence and self-esteem, and Third, there was a significant negative relationship between academic helplessness and self-esteem. It has been found to influence negative relationships. Fourth, smartphone dependence indirectly affects academic helplessness through self-esteem and plays a partial mediating role.

Conclusion: These results are meaningful in that they revealed the indirect mediating effect of self-esteem in the path that smartphone dependence leads to academic helplessness. Therefore, through the results of this study, it was suggested that various programs are needed to reduce smartphone dependence and academic helplessness, and to recognize and improve the importance of self-esteem in the educational field for correct study and growth of adolescents.

Keywords: Adolescents, Smartphone Dependency, Academic Helplessness, Self-Esteem, Mediating Effect

1. Introduction
1.1. The necessity of the research

For teenagers in modern society, smartphones are a means of communication and a necessity to obtain various information, express themselves, and communicate with other friends, and 95.9% of teenagers have smartphones[1]. As a result, adolescents' smartphone dependency was found to be very high at 35.8% compared to 22.2% of adults. In particular, as adolescents spend more time alone, anxiety, depression, and stress levels also increase, the time to use smartphones increases, which is used to relieve those negative psychological conditions[2].

Various discussions and efforts are being made to solve this excessive smartphone use problem. However, as non-face-to-face classes and culture spread due to COVID-19, smartphones have become an essential tool for adolescents to study and interact in their peer communities.
Therefore, it can be said that it is the time when the preventive intervention of adolescents' overuse of smartphones and the resulting problems is important.

Adolescents' excessive use and smartphone dependency can cause physical, emotional, and learning problems. In the physical part, eye fatigue, turtle neck syndrome, muscle pain, and carpal tunnel syndrome may occur[3]. In the emotional part, problems such as decreased concentration, anxiety, and distraction may occur. As learning problems, problems such as decreased concentration and learning time are emerging[4][5].

Prior studies related to adolescents' smartphone dependency and academic helplessness are still insufficient, and related prior studies have mainly focused on Internet addiction, mobile phone addiction, and game addiction affecting adolescents. Looking at similar studies, it was confirmed that when addicted to smartphones, class concentration decreases significantly and academic achievement weakens as well[6]. A study analyzing the correlation between cell phone dependence, parenting attitude, and school life adaptation of middle school students found that there was a negative correlation between cell phone dependence and school life adaptation[7]. It is predicted that there will be a positive correlation between smartphone addiction and academic helplessness.

On the other hand, personal protection factors related to smartphone dependence include self-esteem[8], self-control[9], and self-efficacy[10]. Among them, self-esteem refers to the degree to which one has a positive or negative attitude toward oneself and how valuable an individual feels about oneself. In particular, adolescents' self-esteem has greater influence than any other time period on individual behavior and their future[11]. Therefore, in relation to problem behavior such as smartphone dependency and the development process of psychological descriptions, it is an important variable that contributes to preventing, mitigating, and solving the problem behavior they face[12].

Looking at previous studies on smartphone dependence and self-esteem, Bianchi and Phillips[13] argue that people with low self-esteem avoid self-awareness and can fall into avoidance behavior such as mobile phone addiction rather than the active response in situations they don't like to face. In a study of adolescents and college students, low self-esteem was also found to be a significant influencing factor on smartphone dependence[14]. A study on the effect of smartphone addiction on depression suggested that self-esteem is a very important variable that can prevent depression caused by smartphone addiction[15]. In addition, it was found that problems related to smartphone use are emerging as problems not only for teenagers and adults but also for elementary school students and that excessive use of smartphones by elementary school students can affect their adaptation to school and their stress level[16].

This study deduces that self-esteem can have a mediating effect in the relationship between adolescents' smartphone dependence and their academic records as a personal protective factor. Accordingly, various programs are needed to reduce smartphone dependence and academic helplessness by verifying the mediating effect of self-esteem as a protective factor that can reduce adolescents' smartphone dependency, and recognize and improve the importance of self-esteem in the educational field[17][18].

Therefore, we intend to empirically analyze the increasingly serious smartphone dependency and their effects, and present policy directions for adolescents who rely on smartphones based on the results. In particular, this study empirically verifies the mediating effect of self-esteem in the relationship between adolescents' smartphone dependency and academic helplessness and proposes alternatives at the practical and policy level according to the results.

1.2. The purpose of the study

The purpose of this study is to examine the relationship and effect of adolescents' smartphone dependency, self-esteem, and academic ability, and to empirically verify the mediating effect of self-esteem in the relationship between smartphones and academic helplessness, and the specific goals are as follows.
1) It identifies the degree of adolescents' smartphone dependency, self-esteem, and academic helplessness.
2) Identify the correlation between adolescents' smartphone dependency, self-esteem, and academic helplessness.
3) It identifies the effect of adolescents' smartphone dependency and self-esteem on academic helplessness, and identifies the mediating effect of self-esteem in the relationship between smartphone dependence and academic helplessness.

2. Research Method

2.1. Research design

This research is a descriptive study to empirically verify the mediating effect of self-esteem in the relationship between adolescents' smartphone dependency and academic helplessness.

2.2. Research subjects and data collection

This study is based on data from the Korea Children/Youth Panel Survey (KCYPS) 2018 of the Korea Youth Policy Institute (2019). This data was disclosed (December 01, 2020) and received consent and approval (September 01, 2021). The population of KCYPS is students enrolled in the first grade of middle school as of 2018. The 2017 Basic Education Statistics of the Ministry of Education were used as a sampling framework and samples were taken through a multistage stratified cluster sampling method. As a result, the final 2,590 cohort panel members for first graders in middle school nationwide were gathered. This study was conducted on a total of 2,404 first-year middle school adolescents (1,303 males and 1,101 females), excluding 186 missing values for variables used in the analysis and 2,590 respondents who did not use smartphones.

2.3. Research tool

1) Smartphone dependency

"Smartphone addiction self-diagnosis scale" developed by Kim et al. [19] was used as the smartphone dependence scale in the study. It consists of a total of 15 statements, and representative questions include "I continue using my smartphone while thinking that I should stop using it," "I'm happier using my smartphone than being with my family members or friends," and "I've been unable to focus on what I'm doing (study) because I've been using my smartphone." The score of each question is from 1 point of "Not at all" to 4 points of "Very much so" on the Likert scale. For some questions such as "I am not anxious without a smartphone" and "I don't spend much time using a smartphone," the higher the total score combined by reverse coding, the higher the level of smartphone dependency. The reliability coefficient of this study was Cronbach's $\alpha = .86$.

2) Self-esteem

As for the measure of self-esteem, a total of 10 questions revised and supplemented, based on Rosenberg's scale [20] by the Korea Youth Policy Institute, were used. Negative questions such as "Sometimes I think I'm not good for anything," "I don't feel like there's much to be proud of," "Sometimes I feel useless," "I wish I could be more respectful of myself," and "I tend to feel like a failure" were reverse-coded. The score of each question is from 1 point "Not at all" to 4 points "Very much" on the Likert scale, and the higher the total score, the higher the level of self-esteem. The reliability coefficient of this study was Cronbach's $\alpha = .84$.

3) Academic helplessness
The academic helplessness scale is a scale developed by Park et al. [21], consisting of a total of 16 questions. Representative questions include "I don't think I can overcome the difference in academic skills on my own," "No matter how much I study, I don't think I can do better than now," and "I don't think I can solve academic problems on my own." The score of each question is from 1 point "Not at all" to 4 points "Very much so" on the Likert scale, and the higher the total score, the higher the level of academic helplessness. The reliability coefficient of this study was Cronbach's $\alpha = .92$.

2.4. Data analysis

In this study, data were analyzed using SPSS 25.0 and PROCESS macro version 3.5. First, frequency analysis and descriptive statistics were conducted to examine the general characteristics of the study subjects. Second, descriptive statistical analysis and Pearson correlation analysis were performed on major variables to examine the correlation among major variables. Third, it was analyzed as Hayes[22]'s PROCESS macro(Model 4) to confirm the mediating effect of self-esteem in the relationship between adolescents' smartphone dependency and academic helplessness. Fourth, the significance of the indirect path was confirmed by the bootstrapping technique. By applying the 95% confidence interval, the sample was extracted 5,000 times and the analysis was performed to confirm it. If 0 is not included in the confidence interval, the indirect effect was interpreted as significant at the 95% confidence level.

3. Research Results

3.1. General characteristics of the subject

The general characteristics of the study subjects are as follows <Table 1>. The gender of the study subjects was 1,303 males(54.2%) and 1,101 females(45.8%), so there were more male than female. Looking at the size of the city(based on schools), 1,072 people(44.6%) in large cities, 987 people(41.1%) in small and medium-sized cities, and 345 people(14.4%) in towns and villages. Looking at the administrative district(based on residence), the "do" province(8 places) had the largest number of residents(55.4%). Next, 610 people(25.4%) in metropolitan cities(6), 398 people(16.6%) in Seoul, 39 people(1.6%) in Sejong Special Self-Governing City, and 26 people(1.1%) in Jeju Special Self-Governing Province were confirmed to reside in respective areas.

Table 1. General characteristics.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Categories</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>1,303</td>
<td>54.2</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>1,101</td>
<td>45.8</td>
</tr>
<tr>
<td>City size (school standard)</td>
<td>Metropolis</td>
<td>1,072</td>
<td>44.6</td>
</tr>
<tr>
<td></td>
<td>Small and medium city</td>
<td>987</td>
<td>41.1</td>
</tr>
<tr>
<td></td>
<td>Rural area</td>
<td>345</td>
<td>14.4</td>
</tr>
<tr>
<td>Administrative division</td>
<td>Seoul special city</td>
<td>398</td>
<td>16.6</td>
</tr>
<tr>
<td>(residency standard)</td>
<td>Metropolitan city(6 number)</td>
<td>610</td>
<td>25.4</td>
</tr>
<tr>
<td></td>
<td>Sejong-si</td>
<td>39</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>Do(8 number)</td>
<td>1,331</td>
<td>55.4</td>
</tr>
<tr>
<td></td>
<td>Jeju-do</td>
<td>26</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Note: n=2,404.
3.2. Research subjects' smartphone dependency, self-esteem, and degree of academic helplessness

<Table 2> shows the results of analyzing the scores of smartphone dependence, self-esteem, and academic helplessness of the subjects of this study. The average score for self-esteem was the highest at 2.93(±0.45). The average score for smartphone dependence was 2.13(±0.46) out of 4 points. The average score for academic helplessness was 1.96(±.51). In addition, when looking at the skewness(-0.05~.10) and kurtosis(-.25~.02) of major variables, all the normality assumption criteria that the absolute value of skewness is 3 or less and the absolute value of kurtosis is 10 or less were satisfied[23].

Table 2. Technical statistics analysis of major variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smartphone dependency</td>
<td>2.13</td>
<td>.46</td>
<td>-.05</td>
<td>-.03</td>
</tr>
<tr>
<td>Self-esteem</td>
<td>2.93</td>
<td>.45</td>
<td>.10</td>
<td>.02</td>
</tr>
<tr>
<td>Academic helplessness</td>
<td>1.96</td>
<td>.51</td>
<td>.07</td>
<td>-.25</td>
</tr>
</tbody>
</table>

Note: n=2,404.

3.3. The correlation between study subjects' smartphone dependency, self-esteem, and academic helplessness

<Table 3> shows the results of analyzing the correlation between smartphone dependence, self-esteem, and academic helplessness of the subjects of this study. There was a negative correlation between smartphone dependence and self-esteem(r=-.408, p=.001). There was a positive correlation between smartphone dependence and academic helplessness(r=.421, p=.001). There was a negative correlation between self-esteem and academic helplessness(r=-.519, p=.001). The correlation between smartphone dependence, self-esteem, and academic helplessness was all found to be statistically significant. In addition, the correlation of the main variables showed a value between -.519 and .408, and no correlation was found at the suspected level of multicollinearity. In the regression model, the value of the VIF(variance inflation factor) between variables was 1.369 or less, which did not exceed 10, making it less likely to be a multicollinearity problem[24].

Therefore, it can be seen that the higher the adolescents' smartphone dependency, the lower their self-esteem. In addition, as smartphone dependency increases, academic helplessness increase. In turn, it was confirmed that self-esteem decreases when academic helplessness increase.

Table 3. Correlation analysis between major variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Smartphone dependency</th>
<th>Self-esteem</th>
<th>Academic helplessness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r(p)</td>
<td>r(p)</td>
<td>r(p)</td>
</tr>
<tr>
<td>Smartphone dependency</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-esteem</td>
<td>-.408(.000)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Academic helplessness</td>
<td>.421(.000)</td>
<td>-.519(.000)</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: n=2,404.
3.4. Effect of study subjects’ smartphone dependency on academic helplessness and mediating effect of self-esteem

The effect of adolescents' smartphone dependency on academic helplessness was examined, and the mediating effect of self-esteem in the relationship between the two variables was verified. Table 4 shows the analysis results using PROCESS macro(Model 4).

As a result of analyzing the effect of adolescents' smartphone dependency on academic helplessness, the F value was 516.546 which was statistically significant (p<.001), and the model was suitable. Adolescents' smartphone dependency explained their academic helplessness by 17.7%. Smartphone dependence had a significant positive effect on academic helplessness (β=.463, p=.001). It was confirmed that the higher the smartphone dependency, the higher the academic helplessness. In addition, as a result of analyzing the effect of adolescents' self-esteem on smartphone dependence, the F value was 479.991, which was statistically significant (p<.001), and the model was suitable. Adolescents' self-esteem explained 16.6% smartphone dependency. It was confirmed that self-esteem had a significant negative effect on smartphone dependence (β=-.393, p=.001), so that the higher the self-esteem of adolescents, the lower the smartphone dependency.

On the other hand, as a result of analyzing the effect of adolescents' smartphone dependency and self-esteem on academic helplessness, the F value was 570.275 which was statistically significant (p<.001), and the model was suitable. Adolescents' smartphone dependency and self-esteem explained 32.2% of academic helplessness. Smartphone dependence had a significant positive effect on academic helplessness (β=.276, p=.001), and self-esteem had a significant negative effect on academic helplessness (β=-.476, p=.001). These results confirm that the higher the adolescents' smartphone dependency, the higher the academic helplessness, and the higher the self-esteem, the lower the academic helplessness.

Table 4. The effects of smartphone dependency on academic helplessness and mediating effect of self-esteem.

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Dependent variable</th>
<th>Coef (β)</th>
<th>SE</th>
<th>t</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>Smartphone dependency</td>
<td>Academic helplessness</td>
<td>.463</td>
<td>.020</td>
<td>22.72</td>
<td>.000</td>
<td>.423</td>
</tr>
</tbody>
</table>

R²=.177, F(1, 2402)=516.546 (p<.001)

| Smartphone dependency | Self-esteem | -.393 | .018 | -21.90 | .000 | -.428 | -.358 |

R²=.166, F(1, 2402)=479.991 (p<.001)

| Smartphone dependency | Academic helplessness | .276 | .020 | 13.60 | .000 | .236 | .315 |

| Self-esteem | Academic helplessness | -.476 | .021 | -22.66 | .000 | -.518 | -.435 |

R²=.322, F(2, 2401)=570.275 (p<.001)

Note: n=2,404.
3.5. Verification of statistical significance of the mediating effect of the subject's self-esteem

Bootstrapping was set and analyzed 5,000 times to verify the statistical significance of the mediating effect of self-esteem in the relationship between adolescents' smartphone dependency and academic helplessness, and the results are shown in Table 4. As a result of the analysis, the path through which adolescents' smartphone dependency leads to academic helplessness through self-esteem is .162 to .214 in 95% confidence interval. The mediating pathway was found to be statistically significant because the confidence interval does not contain zero[21]. Therefore, it was confirmed that self-esteem plays a partial mediating role between adolescents' smartphone dependency and academic helplessness, and that smartphone dependency indirectly significantly affects academic helplessness by mediating self-esteem.

Table 5. Significance test of mediation effect of self-esteem.

<table>
<thead>
<tr>
<th>Variable path</th>
<th>Indirect effect</th>
<th>Boot SE</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smartphone dependency → self-esteem → academic helplessness</td>
<td>.187</td>
<td>.013</td>
<td>.162 - .214</td>
</tr>
</tbody>
</table>

Note: n=2,404.

4. Discussion

The purpose of this study is to examine the relationship and influence between adolescents' smartphone dependency, self-esteem, and academic helplessness, and empirically verify the mediating effect of self-esteem in the relationship between smartphone dependence and academic helplessness. Focusing on the research results, we discuss as follows. First, the average score of adolescents' smartphone dependence, self-esteem, and academic helplessness was as follows: 2.93 points for self-esteem, 2.13 points for smartphone dependence, and 1.96 points for academic helplessness. In Kim and Park's study[25], smartphone dependence average was 2.19 points, which was similar to that of this study. Second, as a result of analyzing the correlation between smartphone dependence, self-esteem, and academic helplessness, there was a negative correlation between smartphone dependence and self-esteem. In addition, there was a positive correlation between smartphone dependence and academic helplessness. In addition, the relationship between academic helplessness and self-esteem showed a negative correlation. In other words, the higher the adolescents' smartphone dependency, the lower their self-esteem, and the higher their smartphone dependency, the higher their academic helplessness. In addition, it was confirmed that self-esteem decreased when academic helplessness increased. According to previous studies, there is a negative correlation between adolescents' smartphone addiction and self-esteem, a positive correlation between smartphone dependence and academic helplessness, and a negative correlation between academic helplessness and self-esteem. The results of this study were consistent with the results of these previous studies[26][27].

Third, in this study, the relationship between smartphone dependence and academic helplessness was examined in 2,404 middle school students. As a result, it showed 17.7% explanatory power. Self-esteem played a partial mediating role between adolescents' smartphone dependency and academic helplessness. It was confirmed that smartphone dependency had an indirectly significant effect on academic helplessness by mediating self-esteem. Comprehensive, these results show that various programs are needed to recognize and improve the importance of self-esteem in the educational field for reducing smartphone dependence and academic helplessness and correct academic activity and growth of adolescents.
5. Conclusion and Suggestion

Through the results of this study, the following suggestions are to be made.

First, excessive use of smartphones can lead to an increase in academic helplessness and negatively affect academic performance, so related policies and programs will be needed. According to Busch and Watson[28], concentration and performance decreased by 20% when smart devices were around while performing tasks that required a lot of brainwork. These results confirm that overuse of smartphones negatively affects academic performance[29]. Therefore, it is necessary to develop and apply programs such as learning concentration improvement programs, programs to overcome academic helplessness, and academic motivation improvement programs for students who need to identify and analyze their individual differences.

Second, the lower the self-esteem, the higher the smartphone dependency, and the higher the physical and emotional stress response. This can lead to maladaptive behaviors such as mental illness, alcoholism, depression, suicide, and drug abuse[30]. In addition, since academic performance may decrease due to increased stress and reduced self-esteem[31], positive psychological programs along with health education should be provided to maintain and improve health through positive self-esteem.

This study has verified the mediating effect of self-esteem in the relationship between adolescents’ smartphone dependency and academic helplessness, and found that self-esteem as a protective factor is a predictor. However, since the population was only targeting 2,404 students in the first year of middle school, there is a limit to generalizing the results of this study to all middle school students. As a follow-up study, we would like to propose to investigate the relationship and impact of adolescents’ smartphone dependency and academic helplessness due to COVID-19, and further identify the causes of lowered academic performance to provide basic data on government measures against it.

6. References

6.1. Journal articles


6.3. Books


6.4. Additional references


7. Appendix

7.1. Authors contribution

<table>
<thead>
<tr>
<th>Initial name</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead Author</td>
<td>Set of concepts ☑</td>
</tr>
<tr>
<td></td>
<td>Design ☑</td>
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<tr>
<td></td>
<td>Getting results ☑</td>
</tr>
<tr>
<td></td>
<td>Analysis ☑</td>
</tr>
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<td></td>
<td>Make a significant contribution to collection ☑</td>
</tr>
<tr>
<td>Corresponding Author*</td>
<td>Final approval of the paper ☑</td>
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<td></td>
<td>Play a decisive role in modification ☑</td>
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<tr>
<td>Co-Author</td>
<td>Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑</td>
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<td></td>
<td>Participants in Drafting and Revising Papers ☑</td>
</tr>
<tr>
<td></td>
<td>Someone who can explain all aspects of the paper ☑</td>
</tr>
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7.2. Funding agency

This work was supported by the Gimcheon University Research Grant of 2021(gc21038).