The Influence of Problematic Mobile Phone Use on the Mental Health of Primary School Students

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Abstract. This study investigates the impact of problematic smartphone use on the mental health of primary school students. Through comprehensive methods including questionnaire surveys and data analysis, we conducted a thorough investigation into the current status of smartphone misuse among elementary students. The research reveals multidimensional adverse effects on emotional well-being, cognitive development, and social skills. We propose effective intervention strategies from three dimensions: family support, school education and management, and societal environment cultivation. These measures aim to provide valuable references for promoting the psychological health development of primary school students.

Keywords: Problematic Mobile Phone Use; Primary School Students; Mental Health; Influencing Factors; Intervention Strategies.

1. Introduction

1.1 Research Background

With the rapid advancement of modern technology, smartphones have become an indispensable tool in daily life. According to the latest survey data from the Chinese Academy of Social Sciences, over 60% of students in China own mobile phones [1]. This trend is particularly pronounced among primary school students, who use smartphones not only for communication but also for learning, entertainment, and social interaction. However, the widespread adoption of smartphones has brought about numerous potential issues, with "problematic smartphone use" becoming increasingly prominent. Problematic smartphone use refers to behavioral patterns where individuals develop negative impacts on physical/mental health, social functioning, and academic performance due to excessive reliance on mobile devices [3]. Research indicates that primary school students, whose cognitive, emotional, and physiological development is still immature, are highly susceptible to external factors affecting their mental health. In this context, exploring the impact of problematic smartphone use on primary school students' mental health holds significant practical importance.

1.2 Problem Statement

The adverse effects of problematic smartphone use among primary school students on their mental health have become increasingly evident. Excessive screen time not only leads to sleep disorders, attention deficits, and diminished emotional regulation abilities, but also intensifies smartphone dependency through virtual socializing and gaming stimulation, which in turn triggers anxiety and depressive symptoms[2][5]. While existing research has addressed the risks of problematic smartphone use in adolescents, studies specifically targeting primary school students remain limited which particularly lacking in-depth analysis of mental health impacts. This study aims to bridge this gap by systematically examining the prevalence of problematic smartphone use in elementary education and its specific psychological consequences. Through revealing the underlying mechanisms linking these behaviors to mental health, the research provides theoretical foundations for developing scientifically sound intervention strategies.

1.3 Research Objectives

The primary objectives of this study encompass three key aspects: First, by synthesizing existing literature and empirical data, we aim to clearly define the criteria for problematic smartphone use among elementary school students and conduct a comprehensive analysis of its impacts on their mental health across multiple dimensions including emotional well-being, cognitive development, and social competence. Second, through a longitudinal questionnaire-based study involving 355 students, we will establish a structural equation model with mediating variables to examine the relationships between parental-child bonding, psychological resilience, and problematic smartphone use. Finally, based on these findings, we propose practical intervention and prevention strategies to provide actionable guidance for collaborative management of smartphone usage in families, schools, and society [9].

2. Literature Review

2.1 Theories Related to the Use of Problematic Mobile Phones

Problematic smartphone use refers to behavioral patterns where individuals develop excessive reliance on smartphones, negatively impacting their daily life, mental health, and social functioning. This phenomenon has become a research hotspot in recent years with the widespread adoption of smartphones, primarily defined and characterized through the application of addiction theory in mobile phone usage. Scholars have noted a significant correlation between low self-esteem and problematic smartphone use behaviors. Li Dongfeng's research further revealed that individuals with high approval motivation and self-monitoring traits are more prone to developing such behaviors[4]. Additionally, studies by Chen Qingbin and Jiang Zhiyu [14] demonstrated that loneliness is negatively correlated with smartphone intensity, indicating that socially maladjusted individuals may excessively use phones to alleviate negative emotional experiences, thereby exacerbating their dependence. From an addiction theory perspective, core characteristics of problematic smartphone use include compulsive usage, withdrawal symptoms, and behavioral loss of control that closely resemble substance addiction patterns. Furthermore, Chen Qingbin and Jiang Zhiyu's research uncovered associations between personality traits and illegal smartphone usage, such as individuals with heightened sensation-seeking tendencies being more likely to use phones in risky environments. This not only reflects the diversity of problematic smartphone use but also provides scientific basis for its diagnostic criteria [14].

2.2 Research Progress on Mental Health of Primary School Students

The mental health of primary school students has garnered significant attention in recent years, with research primarily focusing on psychological development characteristics, common mental health issues, and preventive strategies. Yu Rong's study highlights prevalent problems among students, including psychological arrogance or inferiority complexes, behavioral deviations, and immature self-awareness development. These issues often stem from external factors such as inadequate family education and interpersonal anxiety[8]. Yang Xuezhu emphasizes that mental health challenges in primary school students are closely linked to increased academic burdens and insufficient self-control, which not only affect learning efficiency but may also lead to academic disengagement and life confusion[13]. Regarding cognitive development, primary school students' attention spans remain short, their memory primarily relies on rote memorization, and logical thinking capabilities are still developing. In emotional growth, they exhibit significant mood swings and are easily influenced by environmental factors. Socially, while their dependence on peer relationships gradually increases, they still experience tension between reliance on parents and growing independence[8][13]. These findings provide a theoretical foundation for understanding mental health issues in primary school students and underscore the importance of strengthening mental health education.

2.3 Research Status on the Relationship between Problem Mobile Phone Use and Mental Health of Primary School Students

While existing studies have explored the impact of problematic mobile phone use on mental health, research specifically targeting primary school students remains limited. Ji Jingyi, Li Zhenliang, Yao Li, and Li Xinying's research indicates that excessive smartphone use leads to decreased sleep quality, increased anxiety levels, and aggravated depressive symptoms which issues particularly prominent among elementary students. Ji and Li [2][5] emphasize that homework duration, as a physical burden of academic pressure, exacerbates anxiety in young learners, with reduced sleep quality amplifying these negative effects. Additionally, Yao and Li's study reveals that problematic mobile phone use not only affects physical health but also causes profound psychological impacts, including significantly higher rates of mental health issues such as high stress levels, depressive symptoms, and anxiety disorders[5]. However, current research predominantly relies on descriptive analyses, lacking in-depth exploration of causal relationships and long-term consequences. This study's innovation lies in systematically investigating and analyzing data to identify specific manifestations of problematic mobile phone use among primary school students, its multidimensional impacts on mental health, and proposing targeted intervention strategies to bridge existing research gaps.

3. Definition and Research Significance of Problematic Mobile Phone Use among Primary School Students

3.1 Definition of Problem Phone Use

Problematic smartphone use refers to psychological and behavioral abnormalities caused by excessive reliance on mobile devices, characterized by a sense of loss of control over device usage, intense psychological craving, and resulting negative impacts. Behavioral manifestations typically include frequent phone checking, prolonged app engagement, and uncontrollable participation in virtual socializing or gaming activities. In terms of time management, users often exceed normal limits, devoting excessive hours to device operations while sacrificing sleep, study, or social interactions. Psychological dependence serves as the underlying feature, manifested through strong attachment to smartphones and anxiety when disconnected. Research indicates significant correlations between personality traits like low self-esteem, high impulsivity, and sensation-seeking tendencies with problematic smartphone use, further revealing its complex psychological mechanisms. Additionally, it may involve withdrawal symptoms of clinical manifestations, compulsive behaviors and salience phenomena that collectively define the scope of problematic smartphone use.

3.2 Research Plan for Problem-Based Mobile Phone Use Among Primary School Students

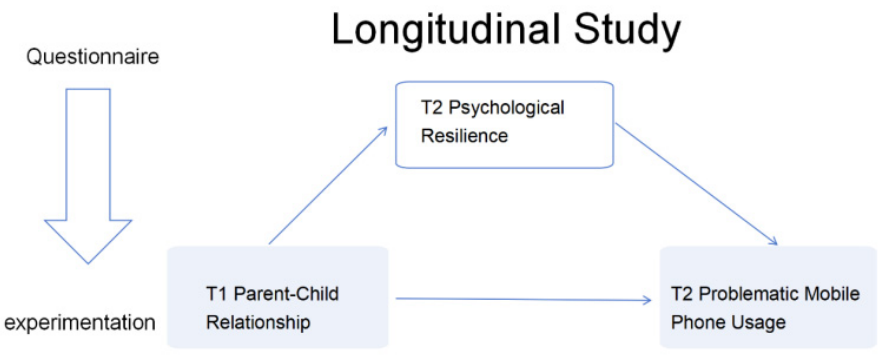


Figure 1. Research Plan Diagram

In order to further understand the current situation of problematic mobile phone use among primary school students, this study will adopt a longitudinal research design based on family risk model and ecosystem theory, select two time points to collect the results data of parent-child relationship, psychological resilience and problematic mobile phone use respectively, and establish a longitudinal mediation model to analyze

3.2.1 Explore the Relationship between Parent-Child Relationship and Problematic Mobile Phone Use From the Perspective of Primary School Students.

3.2.2 A Longitudinal Design was Used to Explore the Relationship between Parent-Child Relationship, Psychological Resilience and Problematic Mobile Phone Use.

3.3 Research Significance

To investigate the relationship and underlying mechanisms between parent-child attachment and problematic mobile phone use among primary school students, this study compares parenting styles and family attachment with the parent-child relationship framework of this research. This approach facilitates a more comprehensive analysis of family influences on problematic mobile phone use in elementary students. The current situation of problematic mobile phone use among primary school students stems from the combined effects of multiple factors including family environment, school education, and social norms. Within family environments, parental parenting styles significantly impact the formation of children's mobile phone usage habits. For instance, indulgent families tend to fulfill children's smartphone demands, while authoritarian families may restrict device use through coercion. However, neither approach effectively guides children toward reasonable phone usage[9]. Problematic mobile phone use has become a concern for both society and schools. This study focuses on exploring how parent-child relationships influence such behaviors and their underlying mechanisms, providing crucial guidance for predicting problematic usage patterns and implementing timely interventions. On one hand, the analysis of family-personal influencing factors helps teachers and school administrators predict future risks of problematic mobile phone use from perspectives of family environment and individual traits. This enables early identification of students at risk of poor parent-child relationships, allowing educators to provide additional care and social connections at home, thereby effectively reducing the risk of problematic usage. Additionally, it reminds parents that many family factors, particularly parent-child relationships, significantly influence children's behaviors, including mobile phone use. Furthermore, research indicates that school educators should prioritize the development and enhancement of parent-child relationships in family education, providing empirical evidence for home-school collaboration in preventing and addressing students' problematic smartphone use. This study validates the ecosystem theory, family risk model, and comprehensive behavioral problem theory framework, enriching existing research on parent-child dynamics and smartphone misuse. It reveals the mechanisms underlying problematic smartphone use among primary school students and constructs a dual-factor model from both familial and individual perspectives. These findings offer theoretical foundations for collaborative solutions between families and schools in tackling smartphone-related issues.

4. Experimental Method and Results

A longitudinal experimental design was used to investigate the relationship model between parent-child relationship, psychological resilience and problematic mobile phone use.

4.1 Experimental Hypothesis

H1: T1 Parent-child relationship can directly negatively predict T2 Problematic mobile phone use;

H2: T1 Parent-child relationship has a positive predictive effect on T2 psychological toughness;

H3: T2 psychological resilience has a negative predictive effect on T2 problematic mobile phone use;

H4: T2 psychological resilience mediates the relationship between T1 parent-child relationship and T2 problematic mobile phone use.

4.2 Subjects

Convenient sampling was adopted to select students from University Road Primary School in Hangzhou, Zhejiang Province. A total of 355 students were selected for the test. The first time point was July 2025, and the second time point was September after two months.

After removing invalid questionnaires, the final number of valid questionnaires was 280, with a validity rate of 78.9%. Among them, there were 137 male students (48.9%) and 143 female students (50.1%), and their age was between 10-13 years old (M = 11.62, SD = 0.54).

4.3 Experimental Tools

4.3.1 Parent-child Relationship

Using the Parent-Child Relationship Scale from the Interpersonal Relationship Scale (IRS) developed by Wo Jianzhong et al. (2001), this study employed a four-item scale with reverse scoring using the Likert-5-point scale (ranging from "completely inconsistent" to "completely consistent"). Higher scores indicate better parent-child relationships. The Cronbach's α' coefficient for this questionnaire in the study was 0.81.

4.3.2 Problematic Mobile Phone Use

The Problematic Mobile Phone Use Questionnaire was employed to assess the severity of problematic mobile phone use among adolescents (Meng et al., 2020). Adapted from the nine clinical criteria for gaming disorder in the DSM-5 (Pontes & Griffiths, 2015) which including questions such as "Have you ever lied to family or friends about your phone usage?" – the questionnaire requires participants to rate each of nine items on a 0-1 scale. Higher total scores indicate more severe problem-solving smartphone use. In Zhou Nan et al. 's (2022) study on adolescents, the Cronbach's α-coefficient for this questionnaire was 0.80, while our research demonstrates a Cronbach's α-coefficient of 0.78.

4.3.3 Psychological Resilience

The CD-RISC-10 scale, developed by Conner and Davidson (2003), revised by Campbell-Sills and Stein (2007), and further refined by Yu and Zhang (2007), was adopted for this study. This version contains 10 items using a 5-point Likert scale (1-5) with "strongly disagree" to "strongly agree". Higher total scores indicate greater psychological resilience. The Cronbach's α' coefficient for this questionnaire was 0.84 in the current study.

4.4 Experimental Results

4.4.1 Descriptive Statistics and Correlation Analysis

Using Pearson correlation analysis, we examined the relationships between variables. The results showed that regarding gender (male=1, female=2), T1 psychological resilience exhibited a significant negative correlation with gender ($r = -0.12$, $p < 0.05$), while T2 parent-child relationship and T2 psychological resilience both demonstrated significant negative correlations with gender ($r = -0.19$, $p < 0.01$). Neither T1 parent-child relationship nor T1 problematic mobile phone use showed statistically significant correlations with gender ($ps > 0.05$). For the demographic variable of being an only child (only child=1, non-only child=2), none of the aforementioned factors showed significant correlations with gender. Regarding place of origin (urban=1, rural=2), T1 parent-child relationship showed a significant positive correlation with place of origin ($r = 0.13$, $p < 0.05$), while T1 psychological resilience, T1 problematic mobile phone use, T2 parent-child relationship, and T2 psychological resilience showed no significant correlations with place of origin ($ps > 0.05$).

Table 1. The average scores, standard deviations, and correlation analysis of each variable (N = 280)

Variable	M	SD	1	2	3	4	5
1. Gender	1.51	0.50	—				
2. Are you an only child?	1.93	0.26	—	—			
3. Place of origin	1.75	0.43	—	—			
4. T1 Parent-child relationship	16.00	3.81	-0.07	-0.02	0.13*		
5. T1 Psychological resilience	36.03	7.06	-0.15*	-0.05	-0.03	0.14*	
6. T1 Problematic mobile phone usage	1.81	1.97	0.06	-0.01	0.03	-0.38***	—0.36***
7. T2 Parent-child relationship	15.41	4.27	-0.20***	-0.04	0.01	0.63***	0.16*
8. T2 Psychological resilience	36.01	7.35	-0.19***	-0.07	-0.06	0.15*	0.56***
9. T2 Problematic mobile phone usage	1.78	2.08	0.06	-0.06	0.02	-0.27***	-0.27***

Note: *p < 0.05, **p < 0.01, ***p < 0.001

Table 1 results indicate that at two distinct time points (T1 and T2), parent-child relationship, psychological resilience, and problematic mobile phone use among elementary school students were significantly correlated. At T1, parent-child relationship showed a significant positive correlation with psychological resilience ($r = 0.14$, $p < 0.05$), while both parent-child relationship and problematic mobile phone use at T1 exhibited significant negative correlations ($r = -0.38$, $p < 0.01$) and ($r = -0.36$, $p < 0.01$), respectively. At T2, parent-child relationship demonstrated a significant positive correlation with psychological resilience ($r = 0.33$, $p < 0.01$), whereas both parent-child relationship and problematic mobile phone use at T2 showed significant negative correlations ($r = -0.41$, $p < 0.01$) and ($r = -0.39$, $p < 0.01$), respectively. Notably, parent-child relationship at T1 showed significant positive correlations with both T2 parent-child relationship ($r = 0.63$, $p < 0.01$) and T2 psychological resilience ($r = 0.15$, $p < 0.05$), while problematic mobile phone use at T2 exhibited a significant negative correlation ($r = -0.27$, $p < 0.01$).

There is a significant negative correlation between T1 psychological resilience and T2 parent-child relationship ($r = 0.16$, $p < 0.05$) and T2 psychological resilience ($r = 0.56$, $p < 0.01$). It shows a significant negative correlation with T2 problematic mobile phone use ($r = -0.27$, $p < 0.01$). Conversely, T1 problematic mobile phone use demonstrates significant negative correlations with both T2 parent-child relationship ($r = -0.40$, $p < 0.01$) and T2 psychological resilience ($r = -0.33$, $p < 0.01$), while showing a significant positive correlation with T2 problematic mobile phone use ($r = 0.65$, $p < 0.01$).

4.4.2 T2 Psychological Resilience in the Longitudinal Mediation between T1 Parent-Child Relationship and T2 Problematic Mobile Phone Use

We conducted paired t-tests using SPSS on parent-child relationship, psychological resilience, and problematic mobile phone use. The results are shown in the table. Parent-child relationship showed significant differences between the two time points ($t(278) = 2.82$, $p < 0.01$), with T2 scores ($M = 15.41$, $SD = 4.27$) significantly lower than T1 scores ($M = 16.00$, $SD = 3.81$). Psychological resilience and problematic mobile phone use demonstrated no significant differences between the two time points ($ps > 0.05$).

Given the limited number of questionnaire items in this study and the need to ensure each item accurately reflects its intended measurement, we analyzed each item as a latent variable indicator rather than grouping them. The latent variables included three dimensions: Parent-Child Relationship (4 indicators), Psychological Resilience (10 indicators), and Problematic Mobile Phone Use (9 indicators). Analysis using Mplus 7.0 yielded favorable model fit parameters: $\chi^2/df = 336.02$, $p < 0.001$, CFI = 0.93, TLI = 0.93, SRMR = 0.05, and RMSEA = 0.04. As shown in Table 3-4, all standardized loadings of the indicators on their respective factors were statistically significant ($p < 0.001$).

Table 2. Descriptive Statistics and Difference Analysis of Parent-Child Relationship, Psychological Resilience and Problematic Mobile Phone Use

	T1 (M±SD)	T2 (M±SD)	t	p
Parent-child relationship	16.00±3.81	15.41±4.27	2.82	<0.01
Psychological resilience	36.03±7.06	36.01±7.35	0.04	0.97
Problematic mobile phone usage	1.81±1.97	1.78±2.08	0.34	0.74

5. The Impact of Problematic Mobile Phone Use on the Mental Health Changes of Primary School Students

5.1 Pairing T-Test and Related Analysis Results of Two Time Point Variables

The paired t-test analysis revealed that the parent-child relationship scores at time point T2 were significantly lower than those at time point T1 ($p < .05$), while psychological resilience and problematic smartphone use showed no significant changes between the two measurement periods. This phenomenon may be attributed to differences in testing timing. The first measurement (T1) was conducted in early July, coinciding with the beginning of the semester when students were generally in a state of academic stress relief. Their focus remained primarily on academic tasks, resulting in relatively stable parent-child interactions that maintained a stable relationship. In contrast, the second measurement (T2) was conducted two months later in September, when students returned to campus after the holiday break. Some students were still adapting to the post-holiday environment, which might lead to resistance or aversion towards parental urging to return to school. Additionally, increased time spent together during the holiday period made both parties more prone to conflicts, ultimately leading to a decline in parent-child relationship quality.

Notably, while parent-child relationship quality shows significant decline over time, problematic smartphone use demonstrates no marked change. Both measurement points revealed a strong negative correlation between parental-child relationships and problematic phone usage. According to Lerner's (2007) developmental contextual theory, individuals form reciprocal and dynamically evolving relationships with their diverse social contexts, particularly manifested through the bidirectional nature of parent-child interactions (mutual influence) and their cyclical evolution over time [15]. This study's findings can be interpreted as follows: When elementary school students exhibit problematic smartphone use behaviors, parents may resort to measures like discipline or punishment, leading to verbal or physical conflicts that ultimately result in parent-child alienation. This indicates the potential existence of a bidirectional reciprocal mechanism between parent-child relationships and problematic smartphone use among elementary school students.

The analysis further demonstrates significant correlations between parent-child relationships, psychological resilience, and problematic smartphone use at both T1 and T2 time points. This indicates that the quality of parent-child relationships, psychological resilience levels, and problematic smartphone behaviors in primary school students maintain relative stability over short-term periods, with their personal traits and behavioral patterns being resistant to drastic changes. To achieve meaningful change, long-term intervention programs may be required. The positive

correlation between parent-child relationships and psychological resilience aligns with existing research findings [16][17], confirming that parental-child relationship dynamics profoundly influence children's ability to cope positively in adversity. The negative correlation between parent-child relationships and problematic smartphone use suggests that such behaviors may correlate with strained parent-child relationships, where conflicts or emotional detachment might drive children toward seeking comfort in the virtual world of smartphones. Additionally, the significant negative correlation between psychological resilience and problematic smartphone use reveals that individuals with higher psychological resilience typically exhibit stronger coping abilities in challenging situations, lower rates of problematic behaviors, and reduced tendencies toward smartphone addiction.

5.2 This Study Constructs a Structural Equation Model (SEM) Integrating Three Latent Variables

Parent-child relationship, psychological resilience, and problematic mobile phone use. The SEM combines measurement models with structural models, combining the strengths of factor analysis and path analysis. This approach not only accounts for measurement errors but also enables simultaneous estimation of multiple relationships while comprehensively evaluating overall model fit, thereby yielding more rigorous, precise, and reliable research conclusions. In the measurement model, all observed indicators demonstrate statistically significant factor loadings, indicating that each latent variable can be effectively explained by its corresponding indicators.

After controlling for gender and place of origin, the structural equation model of T1 parent-child relationship and T2 problematic mobile phone use revealed that T1 parent-child relationship significantly predicts a negative correlation with T2 problematic mobile phone use. This indicates that the quality of parent-child relationship influences subsequent mobile phone usage behavior among primary school students, thereby validating Hypothesis 1: T1 parent-child relationship can negatively predict T2 problematic mobile phone use. This aligns with the findings of...

This finding aligns with previous research findings. Previous studies on parent-child relationships and problematic smartphone use have shown that interactions and communication between parents and children influence adolescents' mobile phone usage behaviors [18]. However, most existing research has primarily examined cross-sectional data. Our study, through longitudinal data analysis, reveals the impact of parent-child relationships on subsequent problematic smartphone behaviors in elementary school students. This result supports ecological system theory [10] (Bronfenbrenner, 1979), social control theory (Rankin & Wells, 1990) [7], and family system theory (Whitchurch & Constantine, 1993) [6]. Parent-child relationships within families are crucial factors influencing the development and formation of problematic behaviors. Harmonious parent-child relationships can reduce the likelihood of adolescents developing problematic smartphone use, while conflict-ridden parent-child dynamics may increase the incidence of such behaviors.

The longitudinal mediation model incorporating T2 psychological resilience, built upon the T1 parent-child relationship and T2 problematic mobile phone use models, demonstrates that T1 parent-child relationship significantly positively predicts T2 psychological resilience, confirming Hypothesis 2. This finding aligns with previous research: Parent-child relationship quality significantly influences children's psychological resilience development, where positive parent-child interactions enhance children's ability to cope with adversity and strengthen their stress resilience [12]. Simultaneously, T2 psychological resilience shows a significant negative predictive effect on T2 problematic mobile phone use, validating Hypothesis 3. This concurs with studies on psychological resilience's impact on problematic mobile phone use: individuals with high psychological resilience can effectively reduce excessive smartphone usage by enhancing self-regulation capabilities[11]. The longitudinal mediation model further reveals that T2 psychological resilience partially mediates the relationship between T1 parent-child relationship and T2 problematic mobile phone use (mediation effect percentage:%), confirming Hypothesis 4. This indicates that parent-child relationships not only directly influence problematic mobile phone use but also indirectly reduce its risk through psychological resilience enhancement.

These findings validate the core mechanism of the Family Risk Model (Repetti et al., 2002): An indifferent or conflict-ridden parent-child relationship hinders the development of psychological resilience, weakens individuals' ability to withstand risk environments, and consequently increases behavioral risks such as problematic smartphone use. Conversely, a harmonious and intimate parent-child relationship enhances psychological resilience, effectively resisting the temptation of harmful behaviors and promoting healthy physical and mental development.

6. Conclusion

Problematic smartphone use hinders authentic social interactions among elementary students, impairing their social skills and interpersonal relationships. Excessive reliance on mobile devices reduces face-to-face communication, weakens the ability to interpret nonverbal cues, and leads to emotional detachment in social connections. Digital entertainment isolates students from real-life experiences, resulting in homogenized social circles that neglect peer interactions and parent-child bonds. Family environment significantly influences smartphone usage: parenting styles (spoiling, authoritarianism, democratic parenting) affect dependency levels; insufficient parental supervision increases addiction risks; positive parent-child relationships reduce dependence and promote mental health. School environment: mobile device management policies (such as device bans) minimize distractions; mental health education helps students cope with dependency; a supportive campus atmosphere reduces risks. Social environment: widespread smartphone use, harmful content, and peer influence exacerbate issues, requiring strengthened regulation to foster a healthy atmosphere. Families should establish clear smartphone usage rules, with parents leading by example and increasing parent-child interactions to reduce dependency. Schools should conduct educational activities (such as themed class meetings) integrated with mental health courses to enhance device management. Society needs government oversight of online environments, media promotion of responsible usage knowledge, and community-organized events like "No Phone Day".

Future research should focus on the risks of new technologies (such as VR/AR), age differences, long-term effects and cross-cultural studies, and deepen understanding with big data analysis, neuroimaging and longitudinal designs.

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