Structural Relationship among Mobile Phone Dependence, Self-Efficacy, Time Management Disposition, and Academic Procrastination in College Students

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Abstract
Background: We aimed to investigate the relationship among mobile phone dependence, self-efficacy for self-regulated learning, time management disposition, and academic procrastination in Chinese students majoring in physical education. In addition, we explored the mediating roles of self-efficacy for self-regulated learning and time management disposition in the relationship between mobile phone dependence and academic procrastination.

Methods: We adopted a random sampling method to identify 324 physical education majors at five universities in Shaanxi Province, China in 2020. Data were analyzed via exploratory factor analysis, confirmatory factor analysis, correlation analysis, structural equation model analysis, and path analysis.

Results: Mobile phone dependence had significant positive effects on academic procrastination ($P<0.001$) and self-efficacy for self-regulated learning ($P<0.05$) but a significant negative effect on time management disposition ($P<0.001$). Self-efficacy for self-regulated learning had a significant positive effect on academic procrastination ($P<0.001$), while time management disposition had a significant negative effect on academic procrastination ($P<0.01$). Notably, self-efficacy for self-regulated learning and time management disposition mediated the relationship between mobile phone dependence and academic procrastination ($P<0.05$).

Conclusion: In addition to its direct effect on academic procrastination, mobile phone dependence exerts an indirect effect via time management disposition and self-regulated learning efficacy. Reducing students’ dependence on mobile phones is necessary for attenuating academic procrastination on university campuses. Thus, universities should aim to restrict the use of mobile phones in the classroom, actively cultivate students’ confidence in their self-regulated learning ability, and educate them regarding appropriate time values.

Keywords: Academic procrastination; Mobile phone dependence; Time management disposition

Introduction

In today's network environment, learning, entertainment, and online payment are all carried out through mobile terminals, and mobile phones have become a common tool in people's daily lives. According to the “Statistical Report on China's Internet Development Status” released.
by the China Internet Network Information Center (CNNIC), as of December 2020, the number of Internet users in China has reached 989 million, and the Internet penetration rate has reached 70.4%, of which mobile Internet users account for the highest proportion (1). Various forms of mobile Internet use have penetrated our daily lives, leading to the development of new social norms and changes in basic lifestyle patterns. However, despite their convenience, mobile phones have been associated with a series of adverse effects including dependence and addiction. National and international studies have verified that excessive or frequent use of mobile phones can impact physical and psychological functioning, quality of life, and performance at work or school (2,3).

Mobile phone dependence refers to an obsessive state in which individuals are unable to control their use of mobile phones, resulting in impaired physiological, psychological, and social functioning (4). Some scholars have also suggested that individuals with such dependence experience anxiety when deprived of mobile phone access (5). College students represent the most active group in the Internet era. According to a 2020 survey, netizens aged 10–39 years account for 61.8% of all Internet users, with those in their 20s accounting for the highest proportion. Research has demonstrated that overuse of mobile phones among college students can also lead to boredom with academic work and a serious tendency to procrastinate (6,7). Therefore, the need to investigate the relationship between mobile phone dependence and academic procrastination remains urgent.

Academic procrastination is defined as the presence of serious procrastination behaviors in the process of learning or completing related tasks. While students affected by academic procrastination typically exhibit the intention and tendency to learn, they do not show behavior consistent with their intentions in actual learning settings (8). Klingsickeck (9) summarized research related to procrastination into the following four perspectives: From the perspective of differential psychology, responsibility and various related aspects are negatively correlated with the degree of procrastination (10), and the degree of academic procrastination is often influenced by low self-discipline and high impulsivity. Procrastination can also be understood in terms of motivation (internal and external motivation, goal orientation, self-efficacy) or volition (self-control, time management, learning strategies, etc.). In addition to affecting learning and performance, habitual procrastination can lead to anxiety, self-blame, low self-esteem, and other negative emotions, in turn leading to various problem behaviors (11).

Time management disposition refers to the psychological and behavioral characteristics displayed by different individuals with regard to time-related values, time monitoring, and time efficacy (12). An individual's disposition for time management is influenced by both external factors and internal factors such as needs-related self-monitoring and personality. A relevant study has reported a significant positive relationship between time management ability and academic performance in college life (13) and that students with poor time management ability tend to procrastinate in their study (14). Individuals who lack self-control are likely to use mobile phones without restraint (15).

Self-efficacy refers to a learning method in which individuals utilize cognitive strategies, self-motivation, behavioral advancement, and active participation (16). Self-regulated learning requires individuals to choose appropriate learning strategies, access their own knowledge level, make self-corrections when necessary, and understand the importance of using appropriate strategies (16). Self-efficacy for self-regulated learning refers to an individual's belief in actively using learning strategies, self-inspection, self-adjustment, and completion of schoolwork (17). Self-efficacy for self-regulated learning is a key factor that can influence and predict academic procrastination (18).

Academic procrastination is considered as a behavioral manifestation of failed self-regulation during learning, in which students cannot use cognitive or motivational strategies. Individuals who procrastinate cannot effectively adjust learn-
ing strategies under high stress and cognitive load to achieve effective learning (19). Therefore, we aimed to investigate the relationships among mobile phone dependence, self-efficacy for self-regulated learning, time management disposition, and academic procrastination in Chinese physical education majors, and to examine whether self-efficacy for self-regulated learning and time management disposition mediate the relationship between mobile phone dependence and academic procrastination. As shown in Fig. 1, we hypothesized that mobile phone dependence exerts significant impacts on academic procrastination (H1), self-efficacy for self-regulated learning (H2), and time management disposition (H3). We also hypothesized that self-efficacy for self-regulated learning exerts a significant impact on academic procrastination (H4), that time management disposition exerts a significant impact on academic procrastination (H5), and that self-efficacy for self-regulated learning and time management disposition mediate the relationship between mobile phone dependence and academic procrastination (H6).

![Fig. 1: Research Model](image)

**Methods**

**Participants**
We adopted a random sampling method to identify physical education majors at five universities in Shaanxi Province, China. A total of 350 questionnaires (Table 1) were distributed following stratified sampling based on gender, grade, and other factors, and 324 questionnaires were effectively returned. All study participants provided informed consent, and the study design was approved by Xianyang Normal University, China.

| Variables      | n  | %  |
|----------------|----|----|
| Gender         |    |    |
| Men            | 228| 70.4|
| Women          | 96 | 29.6|
| Grade          |    |    |
| Freshman       | 155| 47.8|
| Sophomore      | 90 | 27.8|
| Junior         | 57 | 17.6|
| Senior         | 22 | 6.8 |
| Total          | 324| 100|

*Table 1: General participant characteristics*
Assessment Tools
All responses were assessed using a 5-point Likert scale, with scores of 1–5 representing "strongly disagree" to "strongly agree." Reliability and validity were tested using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The aggregate validity index of the average variance extracted (AVE) and construct reliability (CR) were assessed based on previously specified criteria (AVE>0.50, CR>0.70) (20). The results are shown in Table 2.

Table 2: Reliability and validity test results

| Variable                                      | Item          | Estimate | Squared multiple correlation | Standardized residuals | Construct reliability | Average variance extracted | Cronbach's α |
|-----------------------------------------------|---------------|----------|-------------------------------|------------------------|-----------------------|---------------------------|--------------|
| Inability to control craving                  | 1             | 0.646    | 0.417                         | 0.583                  | 0.695                 | 0.432                     | 0.833        |
| 2                                             | 0.706         | 0.498    | 0.502                         |                        |                       |                           |              |
| 3                                             | 0.617         | 0.381    | 0.619                         |                        |                       |                           |              |
| Withdrawal or escape                          | 5             | 0.651    | 0.424                         | 0.576                  | 0.747                 | 0.497                     | 0.842        |
| 6                                             | 0.749         | 0.561    | 0.439                         |                        |                       |                           |              |
| 9                                             | 0.711         | 0.506    | 0.494                         |                        |                       |                           |              |
| Feeling anxious and lost                      | 10            | 0.743    | 0.552                         | 0.448                  | 0.918                 | 0.652                     | 0.933        |
| 11                                            | 0.766         | 0.587    | 0.413                         |                        |                       |                           |              |
| 13                                             | 0.875         | 0.766    | 0.234                         |                        |                       |                           |              |
| 14                                             | 0.821         | 0.674    | 0.326                         |                        |                       |                           |              |
| 15                                             | 0.842         | 0.709    | 0.291                         |                        |                       |                           |              |
| 19                                             | 0.790         | 0.624    | 0.376                         |                        |                       |                           |              |
| Productivity loss                             | 16            | 0.755    | 0.570                         | 0.430                  | 0.744                 | 0.493                     | 0.840        |
| 17                                             | 0.712         | 0.507    | 0.493                         |                        |                       |                           |              |
| 18                                             | 0.635         | 0.403    | 0.597                         |                        |                       |                           |              |
| 2                                               | 0.865         | 0.748    | 0.252                         | 0.976                  | 0.805                 | 0.976                     |              |
| 3                                               | 0.885         | 0.783    | 0.217                         |                        |                       |                           |              |
| 4                                               | 0.873         | 0.762    | 0.238                         |                        |                       |                           |              |
| 5                                               | 0.896         | 0.803    | 0.197                         |                        |                       |                           |              |
| 6                                               | 0.900         | 0.810    | 0.190                         |                        |                       |                           |              |
| 7                                               | 0.907         | 0.823    | 0.177                         |                        |                       |                           |              |
| 8                                               | 0.908         | 0.824    | 0.176                         |                        |                       |                           |              |
| 9                                               | 0.927         | 0.859    | 0.141                         |                        |                       |                           |              |
| 10                                              | 0.886         | 0.785    | 0.215                         |                        |                       |                           |              |
| 11                                              | 0.926         | 0.857    | 0.143                         |                        |                       |                           |              |
| Time values                                    | 0.824         | 0.679    | 0.321                         | 0.903                  | 0.758                 | 0.944                     |              |
| Time efficiency sense                         | 0.980         | 0.960    | 0.040                         |                        |                       |                           | 0.938        |
| Sense of time monitoring                      | 0.797         | 0.635    | 0.365                         |                        |                       |                           | 0.975        |
| 1                                               | 0.722         | 0.521    | 0.479                         | 0.954                  | 0.675                 | 0.954                     |              |
| 2                                               | 0.719         | 0.517    | 0.483                         |                        |                       |                           |              |
| 4                                               | 0.850         | 0.723    | 0.278                         |                        |                       |                           |              |
| 5                                               | 0.859         | 0.738    | 0.262                         |                        |                       |                           |              |
| 7                                               | 0.851         | 0.724    | 0.276                         |                        |                       |                           |              |
| 8                                               | 0.850         | 0.723    | 0.278                         |                        |                       |                           |              |
| 10                                              | 0.807         | 0.651    | 0.349                         |                        |                       |                           |              |
| 11                                              | 0.853         | 0.728    | 0.272                         |                        |                       |                           |              |
| 13                                              | 0.848         | 0.719    | 0.281                         |                        |                       |                           |              |
| 14                                              | 0.837         | 0.701    | 0.299                         |                        |                       |                           |              |

Root mean square error of approximation (RMSEA)=0.070, Tucker-Lewis index (TLI)=0.914, Comparative fit index (CFI)=0.922, $\chi^2=1,642.655$ (p<0.001), $df=634$, $\chi^2/df=2.591$
Cronbach’s α was above 0.80 for all questionnaire variables, indicating high internal consistency of the latent variables and good reliability. Meanwhile, the AVE and CR values were above 0.50 and 0.70, respectively, indicating good polymerization validity of the model.

**Mobile Phone Dependence**
Assessments of mobile phone dependence were based on the Mobile Phone Addiction Index (MPAI) (21) and validated for use in Chinese students by Huang (22). The questionnaire included 20 questions across four aspects. Among them, Cronbach’s α values for inability to control cravings, feeling anxious/lost, withdrawal/escape, and productivity loss were 0.833, 0.933, 0.842, and 0.840, respectively.

**Self-efficacy for Self-regulated Learning**
The Self-Efficacy for Self-Regulated Learning Scale (SESRLS) was based on the questionnaire (23) translated by Wang (24), with proven reliability and validity in the Chinese population. A modified version of the SESRLS with a Cronbach’s α of 0.976 was used in the present study.

**Time Management Disposition**
Time management was assessed based on the Adolescence Time Management Disposition Inventory (ATMD) (25). The questionnaire included 35 questions across the aspects of time values, time efficiency sense, and sense of time monitoring. Cronbach’s α values for these aspects were 0.944, 0.938, and 0.975, respectively.

**Academic Procrastination**
The questionnaire used to assess academic procrastination was compiled by Solomon and Rothblum (26), based on the questionnaire translated. The questionnaire included 10 questions and had a Cronbach’s α of 0.954.

**Statistical Analysis**
We used SPSS and Amos version 25.0 (IBM Corp., Armonk, NY, USA) for data processing and statistical analysis. Data analysis methods included EFA and CFA, correlation analysis, structural equation model (SEM) analysis, path analysis, and detection of mediating effects via bootstrapping. After verifying the fit of the structural relationship of each variable in the hypothetical model, the data were analyzed. Statistical significance was set at \( P<0.05 \).

**Results**
The results of the correlation analysis among mobile phone dependence, self-efficacy for self-regulated learning, time management disposition, and academic procrastination are shown in Table 3. There was a positive correlation between mobile phone dependence and self-efficacy for self-regulated learning (\( r=0.136; P=0.014 \)). The withdrawal or escape factor was positively correlated with self-efficacy for self-regulated learning (\( r=0.143; P=0.010 \)), as was feeling anxious and lost (\( r=0.140; P=0.012 \)). Mobile phone dependence was negatively correlated with time management disposition overall (\( r=-0.168; P<0.001 \)). Both mobile phone dependence (\( r=0.464; P<0.001 \)) and self-efficacy for self-regulated learning (\( r=0.167; P<0.001 \)) exhibited a positive correlation with academic procrastination. There was a negative correlation between time efficiency sense and academic procrastination (\( r=-0.109; P=0.049 \)).

**Suitability of the Research Model**
This study established an SEM to explore the relationship among mobile phone dependence, self-efficacy for self-regulated learning, time management disposition, and academic procrastination. The results indicated that the research model was well fitted, with a goodness-of-fit index (GFI) greater than 0.80 and incremental fit index (IFI), Tucker–Lewis index (TLI), and comparative fit index (CFI) values all greater than 0.90 (Table 4). All fitting indexes were within a reasonable range and met the standards for appropriateness. These results reflect a high degree of fitting between the theoretical model and the survey data, highlighting their suitability for empirical analysis.
Table 3: Correlations among mobile phone dependence, self-efficacy for self-regulated learning, time management disposition, and academic procrastination

| Variable                          | Inability to control craving | Withdrawal or escape | Productivity loss | Feeling anxious and lost | Time value monitoring | Sense of time monitoring | Time efficiency sense | Mobile phone dependence | SESRL | Time management disposition | Academic procrastination |
|----------------------------------|------------------------------|-----------------------|-------------------|-------------------------|-----------------------|-------------------------|------------------------|--------------------------|-------|-----------------------------|--------------------------|
| Inability to control craving     | 1.00                         | 0                     |                   |                         |                       |                         |                        |                          |       |                             |                          |
| Withdrawal or escape             | 0.72                         | 1.000                 |                   |                         |                       |                         |                        |                          |       |                             |                          |
| Productivity loss                | 0.64                         | 0.687**               | 1.000             |                         |                       |                         |                        |                          |       |                             |                          |
| Feeling anxious and lost         | 0.65                         | 0.689**               | 0.706**           | 1.000                   |                       |                         |                        |                          |       |                             |                          |
| Time values                      | 0.19                         | 0.251**               | 0.210**           | 0.08                    | 1.000                 |                       |                        |                          |       |                             |                          |
| Sense of time monitoring         | 0.06                         | 0.123'                | 0.006             | 0.11                    | 0.7                   | 1.000                   |                       |                          |       |                             |                          |
| Time efficiency sense            | 0.16                         | 0.212''               | 0.109'            | 0.15                    | 0.8                   | 0.773''                 | 1.000                   |                          |       |                             |                          |
| Mobile phone dependence          | 0.84                         | 0.865**               | 0.849**           | 0.91                    | 0.1                   | 0.097                   | 0.180                   | 1.000                    |       |                             |                          |
| SESRL                            | 0.10                         | 0.143''               | 0.072             | 0.14                    | 0.6                   | 0.713''                 | 0.848                   | 0.136'                   | 1.0   |                             | 0.00                      |
| Time management disposition      | -                            | 0.212''               | 0.117'            | 0.12                    | 0.9                   | 0.902''                 | 0.937                   | -                         | 0.8   | 1.000                       |                          |
| Academic procrastination         | 0.38                         | 0.367''               | 0.402''           | 0.44                    | 0.0                   | 0.068                   | -                      | 0.464''                  | 0.1   | 0.080                       | 1.000                    |

SESRL, self-efficacy for self-regulated learning

*P<0.05, **P<0.01; tested via correlation analysis

Available at:  http://ijph.tums.ac.ir
Table 4: Suitability of the research model

| Model fit | χ²     | df  | GFI  | NFI  | IFI  | TLI  | CFI  | RMR  | RMSEA |
|-----------|--------|-----|------|------|------|------|------|------|-------|
|           | 1155.032 | 310 | 0.803 | 0.887 | 0.915 | 0.903 | 0.914 | 0.049 | 0.092 |

GFI, goodness-of-fit-index; NFI, normed fit index; IFI, incremental fit index; TLI, Tucker–Lewis index; CFI, comparative fit index; RMR, root mean square residual; RMSEA, root mean square error of approximation

Model fit cutoff values: RMSEA <0.100, TLI ≥0.900, CFI ≥0.900

Hypothesis Verification
We analyzed path relationships among mobile phone dependence, self-efficacy for self-regulated learning, time management disposition, and academic procrastination (Table 5). Among all variables, mobile phone dependence had a significant effect on academic procrastination (β=0.437, P<0.001) and self-efficacy for self-regulated learning (β=0.146, P=0.017). Mobile phone dependence also had a significant negative effect on time management disposition (β=-0.200, P<0.001). Self-efficacy for self-regulated learning (β=0.355, P=0.001) had a significant positive effect on academic procrastination, while time management disposition (β=-0.322, P=0.005) had a significant negative effect on academic procrastination, indicating that a stronger disposition to manage time was associated with less delay in completing school work.

Table 5: Path relationships among mobile phone dependence, self-regulating efficacy, time management disposition, and academic procrastination

| Hypotheses | Path                                | β     | Standard error | Critical ratio | Assessment |
|------------|-------------------------------------|-------|----------------|----------------|------------|
| H1         | Mobile phone dependence → Academic procrastination | 0.437 | 0.061         | 7.717***      | Accept     |
| H2         | Mobile phone dependence → Self-efficacy for self-regulated learning | 0.146 | 0.061         | 2.397*        | Accept     |
| H3         | Mobile phone dependence → Time management disposition | -0.200 | 0.059         | -3.390***     | Accept     |
| H4         | Self-efficacy for self-regulated learning → Academic procrastination | 0.355 | 0.109         | 3.258***      | Accept     |
| H5         | Time management disposition → Academic procrastination | -0.322 | 0.113         | -2.834**      | Accept     |

***P<0.001, **P<0.01, *P<0.05; tested by path analysis

Mediating Effects
We examined the mediating effects of self-efficacy for self-regulated learning and time management disposition on the relationship between mobile phone dependence and academic procrastination using a bootstrapping method with a confidence interval of 95% (Table 6). The lower and upper limits of the confidence interval for
the indirect effects of mobile phone dependence on academic procrastination did not include zero, indicating a significant mediating effect. This finding suggests that mobile phone dependence affects academic procrastination not only directly but also indirectly by influencing self-efficacy for self-regulated learning and time management disposition.

Table 6: Direct, indirect, and total effects

| Path of influence                           | Direct effect | Indirect effect | Total effect |
|---------------------------------------------|---------------|-----------------|--------------|
| Mobile phone dependence → self-efficacy for self-regulated learning | 0.142*        | -               | 0.142*       |
| Mobile phone dependence → time management disposition | -0.201*       | -               | -0.201*      |
| Mobile phone dependence → academic procrastination | 0.492**       | -0.013          | 0.479**      |
| Self-efficacy for self-regulated learning → academic procrastination | 0.378*        | -               | 0.378*       |
| Time management disposition → academic procrastination | -0.332        | -               | -0.332       |

P<0.01, *P<0.05; tested by bootstrap method

Discussion

The present study investigated the relationships among mobile phone dependence, self-efficacy for self-regulated learning, time management disposition, and academic procrastination in college physical education majors, and examined the mediating roles of self-efficacy for self-regulated learning and time management disposition in the relationship between mobile phone dependence and academic procrastination.

In accordance with H1, mobile phone dependence exerted a positive impact on academic procrastination, meaning that greater dependence on mobile phones was associated with more severe procrastination. This is basically consistent with the results of previous studies (7,27). Mobile phone dependence is accompanied by higher levels of anxiety and other negative emotions (28). Academic procrastination also causes anxiety due to unfinished academic tasks, and college students who are addicted to mobile phones often resist spending more time on academic tasks. In daily life, students who rely on mobile phones tend to not only play mobile phone games in their spare time, watch videos, and surf the Internet, but also to use their mobile phones during class time, which delays the completion of academic tasks (29). In light of this situation, some institutions stipulate that students’ mobile phones will be collected in mobile phone storage bags during class to reduce dependence on these devices during class periods.

In accordance with our second hypothesis, we also observed that mobile phone dependence had a positive effect on self-efficacy for self-regulated learning, which is in contrast to previous findings (30). This discrepancy may be because some college students use mobile phones for online learning, e-book reading, and video teaching and learning, which may improve their self-efficacy for self-regulated learning to some extent (31).

As argued in H3, mobile phone dependence had a significant negative impact on time management disposition. That is, greater mobile phone dependence was associated with worse time management ability, which is consistent with the results of previous studies (7,29). Excessive dependence on mobile phones or excessive use of mobile phones can cause students to lose the ability to monitor and manage time, which may be reflected by an inability to plan or a failure to implement plans that have been made. This may
in turn lead to future difficulties conceptualizing time, planning tasks, and learning (32).

In accordance with H4, self-efficacy for self-regulated learning had a positive effect on academic procrastination, suggesting that the degree of academic procrastination decreases with increases in self-efficacy for self-regulated learning. However, this is in contrast to many previous reports that the degree of academic procrastination decreases with increases in self-efficacy for self-regulated learning (29,33). Academic procrastination is a behavioral manifestation of self-regulated learning failure and high self-efficacy for self-regulated learning. When students have enough confidence to manage effectively their studies, they have a positive attitude towards academic problems and seldom experience academic delays. Self-efficacy for self-regulated learning can predict the tendency to procrastinate (18,34). When individuals lack confidence in their ability to complete a task or learn, they are less invested in the task and are prone to evading and delaying the task. When individuals feel that they may not be well-qualified for the task (low sense of efficacy), they experienced higher levels of anxiety, making it easier to procrastinate (11,34). This is consistent with the results of our study.

As noted in H5, time management disposition had a negative impact on academic procrastination. That is, the degree of academic delay tended to increase with poorer time management disposition. This is consistent with the results of previous study (35). Good time values can guide students to develop correct study habits. Related studies have shown that effective time management skills can improve academic performance, while poor time management skills can lead to procrastination (13,14). Time management disposition could predict academic procrastination (36), while poor time management is an important cause of academic delay (37).

Finally, as argued in H6, self-efficacy for self-regulated learning and time management disposition exerted mediating effects on the relationship between mobile phone dependence and academic procrastination. That is, in addition to its direct effects, mobile phone dependence indirectly influenced academic procrastination via self-efficacy for self-regulated learning and time management disposition. This is basically consistent with the results of previous studies (7,32). Individuals who rely on mobile phones may underestimate the value of time and be unable to ration their time due to the pleasure brought by these devices, which may, in turn, lead to academic delays (7).

**Conclusion**

The present findings highlight the direct and indirect effects of mobile phone dependence on academic performance among college students majoring in physical education. Therefore, to reduce academic procrastination, universities should aim to actively cultivate students' confidence in self-regulating learning ability, foster appropriate time values, strengthen time management skills, and promote the ability to adjust one's physical learning state.

**Ethical considerations**

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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**Conflict of interest**

The authors have no conflicts of interest to declare.

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