Original Article

Check for updates

pISSN 2383-6415 eISSN 2383-6423
www.bionursingjournal.or.kr
Journal of Korean Biological Nursing Science 2019;21(3):231-238
https://doi.org/10.7586/jkbns.2019.21.3.231

스마트폰 사용, 수면양상과 간호대학생의 학습몰입도간의 관계

최승혜
가천대학교 간호학과

Relationships between Smartphone Usage, Sleep Patterns and Nursing Students' Learning Engagement

Choi, Seunghye
College of Nursing, Gachon University, Incheon, Korea

Purpose: In 2015, South Korea had the highest global smartphone penetration (88%). However, smartphone addiction can seriously disrupt daily life and have a major negative impact on academic achievement. **Methods:** A structured questionnaire was completed by 250 nursing students for this descriptive study. **Results:** Students who were older, more satisfied with their major, exercised, and used their smartphone for less than 30 minutes before sleeping had higher learning engagement than those who were younger, less satisfied, did not exercise and used their smartphone for more than three hours. Quality of sleep and smartphone addiction were negatively correlated as was quality of sleep and daytime sleepiness. Interestingly, sleep pattern did not impact learning engagement directly. **Conclusion:** Smartphone usage influences learning engagement of nursing students rather than their sleeping patterns, which suggests a need to develop self-disciplining strategies for smartphone use to enhance learning engagement.

Key Words: *Students, Nursing; Learning; Smartphone; Sleep*
국문주요어: 간호대학생, 학습, 스마트폰, 수면

Introduction

In 2015, the smartphone penetration rates were the highest globally in South Korea (88%), followed by Australia (77%), Israel (74%), United States (72%), and Spain (71%) [1]. However, as smartphone become ubiquitous and necessary, it is easy for individual to excessively use their smartphone without being aware of the potential problems. Smartphone addiction can cause serious disruption in individuals' daily lives and academic achievement [2]. College students who are excessively using their smartphones have been reported to be unable to moderate their smartphone usage such that it interferes their daily lives. In fact, smartphones have been reported to lead to some becoming obsessed with them, which contributes to anxiety [3]. Smartphone addiction not only affects daily life but also contributes to sleep disorders [4,5]. In a previous study of smartphone addiction and sleep, it was reported that smartphone addiction led to sleep deprivation, and influence learning engagement in school or class [6,7].

Sleep comprises one-third of human life and is an important factor

Corresponding author: **Choi, Seunghye**
College of Nursing, Gachon University, 191 Hambakmoero, Yeonsu-gu, Incheon, 21936, Korea
Tel: +82-32-820-4201 Fax: +82-32-820-4201 E-mail: hera0511@gmail.com

Received: June 4, 2019 **Revised:** August 13, 2019 **Accepted:** August 14, 2019

that has a great impact on quality of life. Furthermore, inadequate sleep contributes to problems concentrating, memory loss, and daytime fatigue [8,9]. Sleep disturbances can lead to daytime sleepiness, and sleepiness is a common among students [10]. The quality and quantity of students' sleep are closely related to their learning capacity and academic performance [10]. As a result, both smartphones use, and sleep patterns may be related to the learning engagement of nursing students. According to the previous study, learning engagement or flow is the most optimal states for learning, as it is where skill level and challenge level of a task are at their highest [11]. Previous research on association between smartphone use and sleep disturbances were primarily focused on the use of smartphone at night, and there were few studies have included various variables such as smartphone total use time, addiction and learning engagement [12]. Therefore, it is needed to investigate the direct effects of smartphones usage and sleep pattern on learning engagement.

The purpose of this descriptive study was to investigate the degree of learning engagement of nursing college students which could identify strategies for improving learning engagement by improving the field's understanding of the factors influencing the learning engagement. Specific research objectives are as follows; 1) explore the differences in learning engagement according to the general characteristics of nursing students. 2) examine the differences in learning engagement according to the smartphone usage (e.g., total amount of smartphone usage, amount of usage before going to sleep, smartphone addiction). 3) investigate the differences in learning engagement by students' sleep patterns (i.e., total sleep time, subjective sleep satisfaction, sleep quality, daytime sleepiness). 4) explore the association between learning engagement, smartphone addiction, sleep quality, and daytime sleepiness of participating nursing students. 5) identify the factors influencing learning engagement.

Methods

Participants and Recruitment

Study participants were recruited using a convenience sample method. The sample of nursing students was recruited from a university located in Chungbuk, South Korea. Prior to the start of the study, participants expressed an understanding of the intent and purpose of the study and consented to participate in this study. Participants were nursing students in their second to fourth year of college. The researcher elected to exclude first year students because their courses included a larger number of liberal arts classes compared to the other students, which could affect the learning engagement. The sample size for multiple regression was calculated to be 153 participants using G*power 3.1.9.2 program with an effect size of .15, a significant level of .05, power of .95, and number of tested predictors 7. Data were initially collected from 252 participants and these met the minimum number of samples required for the study. Of the 252 original participants, 250 were eligible for final analysis (two were excluded due to incomplete questionnaires).

Measures

1. Background Characteristics

Students' background characteristics collected included age, grade, major satisfaction (very satisfied, satisfied, somewhat, unsatisfied, very unsatisfied), pain (0~10, using numeric rating scale), gender, previous disease (Diseases diagnosed within the past month), drug (drugs taken in the last month), smoking (yes or no), drinking (yes or no), exercise (yes or no), caffeine intake (yes or no).

2. Learning Engagement

The researcher measured learning engagement based nine categories learning flow suggested by Csikszentmihalyi [11]. This was modified, revised, and translated in Korean to assessing a learning engagement [13,14]. Learning engagement was measured on a 5-point Likert scale, with scores ranging from 35 to 175. It consisted two domains of Cognitive Engagement and Affective Engagement, and its subcategories were Challenge-Skill Balance, Action-Awareness Merging, Clear Goals, Unambiguous Feedback, Sense of Control, Concentration on the Task at Hand, Loss of Self-Consciousness, Transformation of Time, Autotelic Experience. In the present study, the measure showed good internal consistency with Cronbach's $\alpha = .94$, and it had a Cronbach's $\alpha = .96$ in the previous study [13].

3. Smartphone Addiction Proneness Scale

The researcher used the adult Smartphone Addiction Proneness Scale that was developed by the National Information Society Agency in Korea [15]. The adult Smartphone Addiction Proneness Scale consists of 15 items on a 4-points Likert scale, with the subfactors of Daily Living Disability, Virtual World Orientation, Withdrawal, and Tolerance [15]. The scores for each factor can be classified into a high-risk group, potential

 https://doi.org/10.7586/jkbns.2019.21.3.231

risk group, and normal user group. The high-risk user group has a total score of 44 points or more, a Daily Life Disability score of 15 points or more, a Withdrawal score of 13 points or more, and a Tolerance score of 13 points or more. Those who are potential risk users have a total score of 40 to 43 points. The normal user group does not meet the criteria for either the high-risk user or potential risk user group, and has the total score is 39 or less, a Daily Living Disability score of 13 or less, a Withdrawal score of 12 or less, and a Tolerance score of 12 or less. Previous research has reported that the reliability of the instrument was Cronbach's α = .81 [15], and in the current study, the reliability was Cronbach's α = .89.

4. Sleep Quality

The quality of sleep was measured using the Korean Version of the Modified Leeds Sleep Evaluation Questionnaire (KMLSEQ) [16], which is used to assess the quality of sleep. It consists of four dimensions including, Getting to Sleep (GTS), the Perceived Quality of Sleep (QOS), the Ease of Awakening from Sleep (AFS), and the Integrity of Behavior Following Wakefulness (BFW). The total KMLSEQ score is calculated by dividing the sum of the scores of all items by the number of questions (0–100), and the higher the total sleep score, the better the sleep quality. A cutoff score on the KMLSEQ that indicates undesirable sleep quality is a score below 66 [16]. Previous research has shown good reliability for the instrument with Cronbach's α = .95 [17], and in the current study, the reliability was Cronbach's α = .79.

5. Daytime Sleepiness.

Daytime sleepiness was measured using the Epworth Sleepiness Scale (ESS) [18]. The items on the measure are rated on a 4-point scale, with a score less than 10 points being normal and more than 10 points indicating daytime sleepiness [18]. Previous research has reported that the reliability of the tool was good (Cronbach's α = .90) [19]. In this study, the reliability of the instrument was Cronbach's α = .68.

Data Collection

The researcher collected data using structured questionnaires from September 2018 to November 2018. The study was approved by the Institutional Review Board (IRB) of S University for the ethical protection of participants (IRB No. SMU-2018-06-004-01). Data were collected after obtaining the permission and cooperation of the nursing departments at the university. The researcher visited the participating students in person, explained the purpose and intent of the study, and collected self-report surveys from those who consented to participate. Because the nursing students were vulnerable subjects, identifiable data did not collect, questionnaire collection was done by investigators not a researcher. The confidentiality and anonymity of the data were also explained to participants, and they were informed that they could refuse or withdraw their participation at any time during the study. Those who consented to participate were asked to provide written consent.

Statistical Analysis

Data were analyzed using SPSS (IBM SPSS Version 23.0; Armonk, NY, USA). The threshold for statistical significance was set at $p < .05$ for all analyses. Independent t-test and one-way ANOVA were conducted to verify the differences in learning engagement according to the general characteristics of the participants, smartphone addiction (i.e., high risk group, potential risk group, and normal user group), sleep quality, and daytime sleepiness. Scheffe's test was used for post-hoc test. Pearson's correlation coefficient was used to investigate the relationship between smartphone usage (i.e., total length of smartphone usage, lengths of usage before going to sleep, smartphone addiction), sleep pattern (e.g., total sleep time, sleep quality, daytime sleepiness) and learning engagement in participants. Finally, a multiple regression was used to identify the factors that independently influencing learning engagement of nursing students.

Results

1. Differences in Learning Engagement by Participants' General Characteristics

Women comprised 87.2% (n = 218) of the sample, and mean age of the entire sample was 21.65 (SD = 3.18) years. Third year students comprised 40.0% (n = 100) of the sample, followed by second year students (34.0%, n = 85), and fourth year students (26.0%, n = 65). Overall, 8.4% of subjects reported very satisfied their major in college, 48.4% were satisfied, 32.8% were satisfied, 9.2% were unsatisfied, and 1.2% were very unsatisfied. Overall 90.0% of participants reported that they did not currently have a disease, and 84.0% reported that they were not currently taking medication. The majority of participants were non-smokers (94.0%; Table 1).

There was a statistically significant difference in learning engagement among the participants according to gender, age, year in school, satisfaction with one's major, exercise, and pain. Men reported being more en-

https://doi.org/10.7586/jkbns.2019.21.3.231

Table 1. Differences in Learning Engagement by Participants' Background Characteristics (N = 250)

Variable	Categories	N (%)	Mean ± SD	t or *F* (*p*)
Age (years)	19–20	94 (37.6)[a]	105.56 ± 15.85	4.87 (.008)
	21–22	104 (41.6)[b]	105.47 ± 17.12	a < c*, b < c*
	≥ 23	52 (20.8)c	113.71 ± 18.03	
Gender	Men	32 (12.8)	113.53 ± 20.15	2.25 (.025)
	Women	218 (87.2)	106.29 ± 16.47	
Grade	2nd	85 (34.0)[a]	106.64 ± 15.91	19.12 (< .001)
	3rd	100 (40.0)[b]	101.33 ± 17.77	a < c*, b < c*
	4th	65 (26.0)[c]	117.05 ± 12.81	
Major Satisfaction	Very Satisfied	21 (8.4)[a]	123.14 ± 10.53	21.96 (< .001)
	Satisfied	121 (48.4)[b]	111.95 ± 15.01	a > b*, b > c*, c > d*
	Somewhat	82 (32.8)[c]	101.77 ± 14.64	
	Unsatisfied	23 (9.2)[d]	87.74 ± 17.47	
	Very Unsatisfied	3 (1.2)[e]	103.33 ± 13.05	
Pain	0	141(56.4)	107.26 ± 17.89	3.89 (.010)
	1–3	70 (28.0)	111.09 ± 14.43	
	4–6	33 (13.2)	101.30 ± 17.16	
	7–9	6 (2.4)	93.67 ± 14.29	
Previous disease	Yes	25 (10.0)	107.12 ± 14.40	-0.03 (.976)
	No	225 (90.0)	107.23 ± 17.40	
Drug	Yes	40(16.0)	109.38 ± 13.99	0.87 (.386)
	No	210 (84.0)	106.81 ± 17.60	
Smoking	Yes	15 (6.0)	113.47 ± 22.93	1.46 (.145)
	No	235 (94.0)	106.82 ± 16.66	
Drink	Yes	133 (53.2)	108.04 ± 16.49	0.81 (.422)
	No	117 (46.8)	106.29 ± 17.82	
Exercise	Yes	71 (28.4)	112.80 ± 14.74	3.31 (< .001)
	No	179 (71.6)	105.01 ± 17.51	
Caffeine	Yes	127(50.8)	106.75 ± 18.10	-0.44 (.659)
	No	123 (49.2)	107.71 ± 16.08	

SD = standard deviation; Post-hoc comparisons were performed using Scheffé tests with significant values being *$p < .05$.

Table 2. Differences in Learning Engagement by Smartphone Usage (N = 250)

Variable	Categories	N (%)	Mean ± SD	*F* (*p*)
Length of Smartphone Use Before Sleep	< 30min	20 (8.0)[a]	112.45 ± 16.93	3.78 (.005)
	30min–1hr	74 (29.6)[b]	110.18 ± 12.72	b > e*
	1hr–2hr	88 (35.2)[c]	108.09 ± 16.76	
	2hr–3hr	35 (14.0)[d]	104.29 ± 22.12	
	≥ 3hr	33 (13.2)[e]	98.21 (17.97)	
Total Time of Smartphone Usage	< 2hr	8 (3.2)	111.88 ± 14.93	1.45 (.217)
	2hr–3hr	36 (14.4)	109.89 ± 18.27	
	3hr–4hr	63 (25.2)	109.44 ± 14.47	
	4hr–5hr	36 (14.4)	102.33 ± 15.88	
	≥ 5hr	107 (42.8)	106.31 ± 18.47	
Smartphone Addiction	High Risk Group	36 (14.4)[a]	98.75 ± 17.45	6.74 (.001)
	Potential Risk Group	52 (20.8)[b]	105.33 ± 16.97	a < c*
	Normal User Group	162 (64.8)[c]	109.71 ± 16.49	

SD = standard deviation; Post-hoc comparisons were performed using Scheffé tests with significant values being *$p < .05$.

gaged in learning than women ($p = .025$), and those who were 23 and older reported significantly higher learning engagement than did those who were 21–22 and 19–20 years old ($p = .008$). Fourth-year students reported significantly higher levels of learning engagement than those in their second or third years ($p < .001$), and students who were very satisfied with their majors stated they had significantly higher learning engagement than those who stated they were satisfied or very unsatisfied ($p < .001$). Participants who exercised reported significantly higher learning engagement than those who did not exercise ($p < .001$; Table 1).

https://doi.org/10.7586/jkbns.2019.21.3.231

Table 3. Differences in Learning Engagement by Sleep-Related Characteristics (N = 250)

Variable	Categories	N (%)	Mean ± SD	t or *F* (*p*)
Total Sleep Time	< 4hr	4 (1.6)	124.00 ± 15.77	1.61 (.171)
	4hr–5hr	25 (10.0)	107.96 ± 16.29	
	5hr–6hr	81 (32.4)	105.19 ± 16.60	
	6hr–7hr	94 (37.6)	108.89 ± 15.67	
	≥ 7hr	46 (18.4)	105.52 ± 17.11	
Sleep Satisfaction	Very Satisfied	14 (5.6)	104.86 ± 24.70	1.30 (.270)
	Satisfied	59 (23.6)	111.25 ± 17.52	
	Moderate	90 (36.0)	107.11 ± 17.64	
	Unsatisfied	73 (29.2)	104.68 ± 14.33	
	Very Unsatisfied	14 (5.6)	106.50 ± 15.56	
KMLSEQ	Good	78 (31.2)	110.13 ± 17.69	1.20 (.275)
	Bad	172 (68.8)	105.90 ± 16.73	
ESS	Normal Group	8 (3.2)	106.63 ± 23.77	1.18 (.278)
	Daytime Sleepiness Group	242 (96.8)	107.24 ± 16.91	

SD = standard deviation; KMLSEQ = Korean Version of the Modified Leeds Sleep Evaluation Questionnaire; ESS = Epworth sleepiness scale.

Table 4. Correlation between Learning Engagement, Smartphone Addiction, Sleep Quality, and Daytime Sleepiness Scale (N = 250)

	Learning Engagement	Smartphone Addiction	KMLSEQ	ESS
		r (*p*)		
Learning Engagement	-		.	.03 (.631)
Smartphone Addiction	-.38 (< .001)	-		.06 (.338)
KMLSEQ	.90 (.156)	-.16 (.013)	-	-.16 (.012)
ESS	.03 (.631)	.06 (.338)	-.16 (.012)	1

KMLSEQ = Korean Version of the Modified Leeds Sleep Evaluation Questionnaire; ESS = Epworth sleepiness scale.

Table 5. Multiple Regression Model of Factors Influencing Learning Engagement (N = 250)

Criterion variable	Predictor variables		*B*	*SE*	β	*t* (*p*)
Learning Engagement	Gender	Female	-1.21	2.89	-.024	-0.42 (.677)
	Age		-0.10	0.32	-.019	-0.33 (.745)
	Grade	3rd	-4.04	2.19	-.116	-1.85 (.065)
		4th	6.77	2.57	.174	2.64 (.009)
	Major satisfaction	Satisfied	-8.96	3.47	-.262	-2.58 (.010)
		Somewhat	-18.09	3.61	-.497	-5.00 (< .001)
		Unsatisfied	-26.11	4.58	-.442	-5.70 (< .001)
		Very Unsatisfied	-13.02	8.92	-.083	-1.46 (.146)
	Pain		-0.099	0.456	-.012	-0.216 (.829)
	Exercise	No	-4.86	2.08	-.128	-2.34 (.020)
	Using time of smartphone before sleep	30 min–1 hr	-1.64	3.66	-.044	-0.45 (.654)
		1 hr–2 hr	-1.36	3.66	-.038	-0.37 (.711)
		2 hr–3 hr	-4.92	4.19	-.100	-1.17 (.241)
		≥ 3hr	-9.10	4.22	-.180	-2.16 (.032)
	Smartphone Addiction	Potential Risk Group	4.79	3.13	.114	1.53 (.127)
		Normal User Group	3.54	2.79	.099	1.27 (.205)
		Model *F* (*p*)	9.29 (< .001)			
		Adjusted R^2	.33			

Dummy variables: Gender (M = 0), Major satisfaction (Very satisfied = 0), Exercise (Yes = 0), Using time of smartphone before sleep (< 30min = 0), Smartphone addiction (High risk group = 0)

2. Differences in Learning Engagement by Smartphone Use

There was a statistically significant difference between the learning engagement and the amount of time spent using a smartphone before going to sleep and smartphone addiction. The results of the post-hoc analyses showed that students who used the smartphone for 30 minutes to 1 hour before going to sleep had a significantly higher learning en-

https://doi.org/10.7586/jkbns.2019.21.3.231

gagement than did those who used their smartphone for more than three hours before sleep (p = .005). On the Smartphone Addiction Proneness Scale, the normal user group reported higher learning engagement than did the high-risk group (p = .001; Table 2).

3. Differences in Learning Engagement by Sleep Patterns

There were no statistically significant differences in learning engagement according to total sleep time (p = .171), sleep satisfaction (p = .270), sleep quality (p = .275) and daytime sleepiness (p = .278; Table 3).

4. Correlation between Learning Engagement, Smartphone Usage, Sleep Quality, and Daytime Sleepiness

Learning engagement and smartphone addiction were negatively correlated (p < .001); however, they were not significant correlated with sleep quality and daytime sleepiness. There was a significant negative correlation between smartphone addiction and sleep quality (p = .013), but not with daytime sleepiness. Sleep quality was negatively correlated with daytime sleepiness (p = .012; Table 4).

5. Factors Associated with Learning Engagement

To identify the factors associated with students' learning engagement, a multiple regression analysis (enter mode) was conducted that included the variables of gender, age, year in school, satisfaction with one's major, pain, exercise, length of smartphone use before sleep, and smartphone addiction. In this regression model, the Durbin-Watson statistic was 2.349, which means that there was no autocorrelation, and the tolerance was .253 ~ .938, and the value of variance inflation factor, VIF was 1.066~3.956, therefore it was confirmed that there was no problem with multicollinearity.

The results indicated that compared to participants who did not exercise those who did not exercise (p = .020) were less engaged in learning. Similarly, those who were satisfied, somewhat satisfied, unsatisfied compared to those who were very satisfied with their major (p = .010, p < .001, p < .001, respectively), and those who used their smartphone more than three hours before going sleep compared to those who used it for less than 30 minutes (p = .032) were less engaged in learning. Students in their second year had lower learning engagement than those in their fourth year (p = .009). This model explained 33.3% of the variance in students' learning engagement (F = 9.29, p < .001; Table 5).

Discussion

This study attempted to identify factors associated with the learning engagement of nursing college students and to investigate the effects of smartphone usage and sleep pattern on learning engagement.

In the present study, the mean of learning engagement was 3.06, which was slightly lower than in the previous study in Korea (M = 3.34, SD = 0.42) [13, 20]. The general results showed that men, more senior students, older students, and those who were more satisfied with their major had higher learning engagement. These results consistent with previous research that demonstrated that students in their fourth year showed a higher level of learning engagement than those in other year [21], and that higher the satisfaction with one's major was associated with higher learning engagement [22].

In order to investigate the effects of smartphone usage and sleep patterns on learning engagement, the researcher examined smartphone usage in terms of total length of time using one's smartphone, usage time before sleep, and smartphone addiction. Moreover, the researcher assessed sleep patterns that included subjective sleep satisfaction, quality of sleep, and daytime sleepiness.

Our findings demonstrate that smartphone addiction and lengthy smartphone use time before sleep were more detrimental to learning engagement than was the total usage time of smartphone. Multiple regression showed that factors influencing learning engagement were year in school, satisfaction with one's major satisfaction, exercise, and using one's smartphone for three or more hours before going to sleep. Thus, the learning engagement of the highly risk group on the Smartphone Addiction Proneness Scale was significantly lower than that of the normal user group. Previous research has reported that smartphone addiction can cause serious disruption to individual's daily life and academic work [2], and that college students who are overly immersed in smartphones may become unable to control their smartphone usage which leads to disruptions in daily life [3]. In fact, 46.1% of smartphone users report putting their smartphone near them or sleeping with it in their hands before bedtime [3]. In this study, when the researcher asked about smartphone use before sleep, only 8.0% of subjects reported they used it for 30 minutes or less and 92% reported that they spent more than 30 minutes on their smartphone. Among these students, 13.2% stated they used it for more than three hours. Therefore, it is critical for nursing students to reduce the length of time they are using smartphone before going to sleep.

https://doi.org/10.7586/jkbns.2019.21.3.231

Although the researcher hypothesized that smartphone usage before sleep would affect students' sleeping patterns and possible interfere with learning engagement, there were no significant correlations between learning engagement and total sleep time, subjective sleep satisfaction, and daytime sleepiness.

This is an unexpected finding that was contrary to previous research that reported improper sleep patterns to be associated with learning engagement [23]. This may be due to the fact that our sample was comprised of college students in their early 20s. On study found that the college students felt daytime sleepiness even though they had sufficient sleep, due to inconsistent circadian rhythms and that students with eveningness-type circadian pattern were common than morningness-type [24]. Similarly, in the present study, 56% of participants reported they slept more than six hours, but daytime sleepiness was reported by 96.8% of the students. These factors could affect the relationship between sleep patterns and learning engagement in this study. However, the quality of sleep was found to show a significant correlation with daytime sleepiness, and as the quality of sleep decreased, daytime sleepiness increased in our participants.

A study reported that approximately 25% of participants found that their academic achievement was adversely affected since they started using their smartphones [25] while another found that 44.4% of the participants complained of headaches, decreased concentration, memory loss, hearing loss, and fatigue due to the use of their mobile phones [26]. Moreover, undergraduate college students with an external locus of control, in comparison with those with an internal locus of control, have been shown to have less control over their smartphone use, so that they are more likely to use their phones at bedtime, in class, and while studying. Thus, they are more vulnerable to negative outcomes associated with excessive smartphone use, such as poor sleep quality, lower academic performance, and a reduced degree of subjective well-being [27]. It is possible that in this study, due to the internal locus of control of the students who did exercise. they were more engaged in learning than those who did not exercise.

The researcher found that the significant factors that were independently associated with learning engagement in the regression analysis include year in school, satisfaction with one's major, and amount of time using one's smartphone before going to sleep. Therefore, by increasing student's satisfactions with their major in the early years of nursing school, particularly, and reducing the amount of time using one's smartphone before going to sleep, the learning engagement among nursing college students could be enhanced.

Conclusions

The results of this study indicated that the year in school, satisfaction with one's major, participating in exercise, and smartphone usage before going to sleep were independent factors that influenced learning engagement; however, sleep patterns were not a direct influence on learning engagement. The limitations of this study are that the researcher did not measure the impact of academic achievement because the researcher only measured learning engagement. In addition, it is difficult to generalize these findings to all college students because were only targeted nursing students in college at one local university. Future research should include a prospective study to investigate the influence of smartphone usage on academic achievement in nursing students.

CONFLICT OF INTEREST

The author declared no conflict of interest.

REFERENCES

1. Ryu SS, Nam GW, Eom NR. The survey on Internet overdependence in 2016. Final report. Seoul: Korea National Information Society Agency; 2016. NIA V-RER-C-16026
2. Park MJ, Ryu SY, Park J, Han MA. The effects of smartphone addiction on sleeping time and sleep deprivation among some college students. Journal of Health Informatics and Statistics. 2015; 40(1): 50–61.
3. Oh KT, Lee JE. The 'Smart Life' revolution and smart phone addiction. Internet and Information Security. 2012; 3(4): 21–43.
4. Heo JY, Kim SH, Han MA, Ahn YJ. Correlation between smartphone addiction and quality of sleep among university school students, graduate students. The Journal of the Korea Institute of Electronic Communication Sciences. 2015; 10(6): 737–748. https://doi.org/10.13067/JKIECS.2015.10.6.737
5. Park MJ. The effects of smartphone addiction on sleeping time and sleep deprivation among some college students [master's thesis]. Gwangju: Chosun University; 2014. 37p.
6. Jang R. How game addiction and smart phone addiction affects teens physical health [master's thesis]. Seoul: Myongji University; 2013.62p.
7. Kim BY, Suh KH. Mobile phone and internet game addiction, and stress responses of high school students: The mediating effect of sleep deprivation. The Korean Journal of Health Psychology. 2012; 17(2): 385–398. https://doi.org/10.17315/kjhp.2012.17.2.007
8. Kim MH. The effects of morningness-eveningness, depression, and smart-

phone use on sleep quality of college students [master's thesis]. Daegu: Keimyung University; 2014.67p.
9. Suk HJ, Na YK, Hong HS. Difference in sleep circadian rhythm and sleep quality between normal-weight and obese group. Journal of Korean Biological Nursing Science. 2014; 16(4): 309–317. https://doi.org/10.7586/jkbns.2014.16.4.309
10. Curcio G, Ferrara, M, De Gennaro L. Sleep loss, learning capacity and academic performance. Sleep Medicine Reviews. 2006; 10(5): 323–337. https://doi.org/10.1016/j.smrv.2005.11.001
11. Csikszentmihalyi M. Flow: The Psychology of Optimal Experience. New York: Harper & Row; 1990. p 1-9.
12. Chung JE, Choi SA, Kim KT, Yee J, Kim JH, Seong JW, et al. Smartphone addiction risk and daytime sleepiness in Korean adolescents. Journal of Paediatrics and Child Health. 2018; 54: 800-806. https://doi.org/10.1111/jpc.13901
13. Lee JH. Analysis of the structural relationships among self-determination motivation to learn, metacognition, self-directed learning ability, learning flow, and school achievement [dissertation]. Cheongju: Chungbuk National University; 2009. 204p.
14. Seok IB. The structure of learning flow: scale, character, condition, involvement [dissertation]. Daegu: Kyungpook National University; 2007.239p.
15. Shin KW, Kim DI, Jung YJ. Development of Korean smartphone addiction proneness scale for youth and adults. Final report. Seoul: National Information Society Agency. 2011. 42-53p.
16. Kim IG, Choi HJ, Kim BJ. Psychometric properties of Korean version of modified leeds sleep evaluation questionnaire (KMLSEQ). Korean Journal of Rehabilitation Nursing. 2014; 17(1): 10–17. https://doi.org/10.7587/kjrehn.2014.10
17. Kim MY, Cho SH, Lee SM, Jung SJ, Park KS. Elderly sleep pattern and disturbing factors before and after hospitalization. Journal of Korean Academy of Nursing. 1999; 29(1): 61–71. https://doi.org/10.4040/jkan.1999.29.1.61
18. Johns MW. Sleepiness in different situations measured by the Epworth Sleepiness Scale. Sleep. 1994; 17(8): 703–710. https://doi.org/10.1093/sleep/17.8.703
19. Cho YW, Lee JH, Son HK, Lee SH, Shin C, Johns MW. The reliability and validity of the Korean version of the Epworth sleepiness scale. Sleep and Breathing. 2011; 15(3): 377–384. https://doi.org/10.1007/s11325-010-0343-6
20. Oh YJ, Kang HY. (2013). Metacognition, learning flow and problem solving ability in nursing simulation learning. Journal of Korean Academy of Fundamentals of Nursing. 2013; 20(3): 239–247. https://doi.org/10.7739/jkafn.2013.20.3.239
21. Han SY. A study on the relationships among smart phone addiction, learning-flow, and learning achievement of nursing students. Journal of Learner-Centered Curriculum and Instruction. 2015; 15: 987–1003.
22. Kim YS. Academic stress, daytime sleepiness, depression and learning flow in nursing students. Asia-pacific Journal of Multimedia Services Convergent with Art, Humanities, and Sociology. 2018; 8: 867–883. https://doi.org/10.21742/AJMAHS.2018.05.64
23. Kim HJ, Lee JH, Choi KG, Park KD, Chung EJ, Kim EJ, et al. Effects of sleep deprivation on attention and working memory in medical residents and interns. Journal of the Korean Sleep Research Society. 2006; 3(2): 85–92. https://doi.org/10.13078/jksrs.06015
24. Selvi Y, Kandeger A, Boysan M, Akbaba N, Sayin AA, Tekinarslan E, et al. The effects of individual biological rhythm differences on sleep quality, daytime sleepiness, and dissociative experiences. Psychiatry Research. 2017; 256: 243–248. https://doi.org/10.1016/j.psychres.2017.06.059
25. Alosaimi FD, Alyahya H, Alshahwan H, Al Mahyijari N, Shaik SA. Smartphone addiction among university students in Riyadh, Saudi Arabia. Saudi Medical Journa. 2016; 37(6): 675–683. https://doi.org/10.15537/smj.2016.6.14430
26. Hawi NS, Samaha M. To excel or not to excel: Strong evidence on the adverse effect of smartphone addiction on academic performance. Computers & Education. 2016; 98: 81–89. https://doi.org/10.1016/j.compedu.2016.03.007
27. Li J, Lepp A, Barkley JE. Locus of control and cell phone use: Implications for sleep quality, academic performance, and subjective well-being. Computers in Human Behavior. 2015; 52: 450–457. https://doi.org/10.1016/j.chb.2015.06.021