



RESEARCH ARTICLE

## Association Between Self-Directed Learning Ability and Academic Performance of Korean Physical Therapy College Students Under Covid-19 Stress: A Cross-Sectional Study

Hyo-Lyun Roh<sup>1</sup>, Sun-Wook Park

Department of Physical Therapy, Kangwon National University, Samchuk, Kangwondo, South Korea

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ABSTRACT

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**\*Corresponding Author:**

swpt.park@kangwon.ac.kr

This study investigates the correlation between depression, anxiety, and stress among college students engaged in online learning during the 2019 COVID-19 pandemic and self-directed learning (SDL) ability to provide a scientific basis for college students' mental health education.

A cross-sectional study was conducted with 680 students from colleges and universities in South Korea. The Depression, Anxiety, and Stress Scale-21 (DASS-21) and the SDL ability scale were used to conduct an online questionnaire survey. COVID-19 stress was higher in male than in female students; students with high grades had the highest level of social distancing stress among the COVID-19 stress, and students with low and middle grades had the lowest level of social distancing stress among the COVID-19 stress. It was found that students with excellent grades decreased their grades by 0.761 times (OR=.761) if their SDL evaluation was poor, and students with poor grades increased their grades by 1.379 times (OR=1.379) if their SDL evaluation was good. Therefore, among SDL abilities, SDL evaluation appears to have the greatest influence on students' grades under COVID-19 conditions. COVID-19 Stress was affecting college students' grades. In addition, among the SDL abilities in the coronavirus situation, self-learning evaluation was found to have the greatest influence on student grades in the top and bottom ranks.

## INTRODUCTION

The COVID-19 outbreak has had a significant impact on the lives and livelihoods of worldwide populations since the World Health Organization declared it a global pandemic in March 2020. The COVID-19 pandemic is creating psycho-emotional confusion in people, such as a sharp increase in mental health problems, including anxiety, depression, stress, sleep disorders, and fear (Islam et al. 2020). Large-scale infectious disease outbreaks can cause severe stress and emotional difficulties (Main et al. 2011), and the COVID-19 pandemic has caused stress in many people (Lakhan et al. 2020). In particular, uncertainty about the COVID-19 situation, fear of infection, health threats, and confusion caused by changes in daily life have been shown to cause significant stress (Cao et al. 2020; Duan & Zhu 2020). The COVID-19 pandemic made it difficult for college students to adjust to college life, as they experience a life different than they expected (Kang et al. 2021). In addition to changes in their daily lives, college students are experiencing changes in various fields, including in teaching methods from traditional face-to-face to online education, social isolation, decreased peer support, and changes in employment situation (Chang et al. 2021a; Chang et al. 2021b). The COVID-19 pandemic has caused problems in several aspects of education. The International Labour Organization's (2020) "Youth and COVID-19: Impacts on jobs, education, rights, and mental well-being" report found that the pandemic has made young people's jobs and employment prospects

uncertain and disrupted their education and training. According to a recent survey of 20,000 students by Youth Truth, an American nonprofit research organization, self-directed learning (SDL) is the key to remote learning success during a pandemic (Sun et al. 2023).

SDL is a series of processes in which learners diagnose learning needs and establish learning goals without the help of others, secure human and material resources for learning, choose appropriate learning strategies, and evaluate their own results (Knowles 1975). SDL of college students was voluntary before COVID-19, but SDL after COVID-19 has a different meaning in that it does not form a voluntary choice. SDL ability is the ability to plan and learn on one's own in any situation or context without third-party assistance. With the difficulty of predicting the end of the COVID-19 situation, SDL ability becomes an essential factor for college students.

SDL can be an important determinant of academic performance (Tio et al. 2016) and is recognized as the core of lifelong learning (Dyanan et al. 2008). It is effective in improving academic performance because it motivates learners and allows them to control progress at their own pace (Park & Shin 2021). This is because health profession education concerns not only acquiring knowledge and skills but also clinical learning (Rafi et al. 2020). Learners learn how to build confidence, improve communication skills, and promote team building and networking through face-to-face experience in a practical clinical environment (Singaram et al. 2022). It is also very important for college students in physical therapy departments to acquire professional knowledge about patient treatment through face-to-face learning and progress academically to become competent physical therapists. Therefore, it is important to investigate the relationship between SDL ability and academic performance of college students in the Department of Physical Therapy during COVID-19 stress.

This study examines whether differences exist in the stress level among college students based on their general characteristics (discipline, gender, grade) and grades during COVID-19 stress and investigates the relationship between SDL and academic performance. We expect that the analysis of SDL factors affecting the academic performance these subjects will provide basic data for students' academic performance under similar epidemic situations.

## **MATERIALS & METHODS**

### **Design and Subjects**

This cross-sectional study was conducted in 27 physical therapy colleges. In Korea, physical therapy departments operate three or four year courses, with 48 four-year colleges and 21 three-year colleges. In this study, 644 physical therapy students from 11 three-year and 16 four-year colleges participated. A total of 316 (52.4%) students from three-year colleges and 328 (47.6%) students from four-year colleges participated, and the numbers of students from the three- and four-year physical therapy departments were similar. This study used simple random sampling, which best represents the group, and more than 5% of the group met, which is more than 10 times the number of the nine variables (gender, discipline, academic performance score, three questions about COVID-19 stress, and SDL) used here. Prior to participation, all participants were informed about the study's aims and procedures, and signed informed consent forms. This study conformed to the ethical principles of the Declaration of Helsinki.

### **Survey Instrument**

An online platform developed using Naver Form was used to distribute the e-questionnaire to the students. The online questionnaire consisted of four parts: sociodemographic characteristics, academic grades, COVID-19 stress, and SDL. Academic grades were determined using a self-designed online questionnaire. COVID-19 stress and the validity and reliability of the questionnaire were tested.

### **Demographics**

This section included questions related to the participants' age, gender, grades, college level (freshmen, sophomores, juniors, seniors), and college discipline type (3-year, 4-year).

### **Academic performance score**

Academic performance was scored on a five-point Likert scale ranging from 1=High, 2=Middle-High, 3=Middle, 4=Middle-Low, and 5=Low. Students were asked to respond according to what they felt was appropriate to represent their grades. The higher the score, the lower the students' performance.

### COVID-19 Stress Scale for Korean People (CSSK)

To measure the stress experienced by college students owing to COVID-19, we used the CSSK developed by Kim et al. (2021) (Kim et al. 2021). The CSSK has 21 items, including three sub-items on fear of infection, difficulty with social distancing, and anxiety about others, with a total score of 105 points. Each question is measured on a Likert scale (1 to 5 points) from 1 (not at all) to 5 (very much), with higher scores indicating a higher level of stress. At the time of scale development, the Cronbach's  $\alpha$  was 0.914 and the Cronbach's  $\alpha$  of each sub-factor was fear of infection = 0.925, difficulties owing to social distancing = 0.808, and anger toward others = 0.890 (Kim et al. 2021). Cronbach's  $\alpha$  for all questions was 0.930, fear of infection  $\alpha$  = 0.936, difficulties owing to social distancing  $\alpha$  = 0.840, and anger toward others  $\alpha$  = 0.897. In this study, the Cronbach's  $\alpha$  reliability coefficients for each subscale were also good, indicating a good internal consistency for each subscale.

### SDL ability

Students' SDL ability was measured using a validated Korean version of the SDL Ability Scale for college students (Heo 2021). A total of 14 items included three subscales: (1) SDL planning: five items, including the ability to study due date, learning progress, study planning period, proactiveness (e.g., "I will do it tomorrow without anyone else urging me to do it"); (2) SDL execution: four items, including keeping deadlines, taking notes on important topics, completing assignments, completing tasks (e.g., "I always finish assignments on time"); (3) SDL evaluation: five items, including the ability to exert effort, self-evaluation, comparison with others, researching ways to perform better (e.g., "Even if it is a completed task, study ways to do better"). Each item is scored on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The total SDL ability score was the sum of the scores for each item, with higher scores indicating a higher SDL ability. The SDL questionnaire had high reliability and validity (Heo 2021). In this study, the Cronbach's  $\alpha$  for learning planning, learning execution, and learning evaluation subscale was 0.818, 0.848, and 0.828, respectively, indicating a good internal consistency for each subscale.

### Data Analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (version 26.0) for Windows. The mean (SD) and percentages were used for the descriptive analysis. First, Kolmogorov-Smirnov tests assessed the normality of the distribution of the CSSK and SDL scores. Our results showed that CSSK scores did not follow a normal distribution, whereas SDL scores did ( $p < 0.05$ ).

An independent samples t-test was conducted to examine the differences by gender in the CSSK, a one-way ANOVA was conducted to examine the differences by academic performance, and a Bonferroni test was conducted for the post-hoc test. To examine the impact of SDL ability on grades, a multinomial logistic regression analysis was conducted, with grades set as 'excellent=1' for the upper and upper-middle grades, 'poor=2' for the lower-middle grades, and 'fair=3' for the middle grades.

## RESULTS

### 1. Sample Characteristics

A total of 644 students were enrolled: 262 males (41.9%) and 366 females (58.1%). The mean age of the males was  $22.98 \pm 2.50$  years and the mean age of the females was  $21.10 \pm 2.01$  years, with an overall mean age of  $21.88 \pm 2.41$  years. There were 316 (49.1%) three-year physiotherapy students and 328 (50.9%) four-year physiotherapy students.

**Table 1. General characteristics of the college students** n (%)

Sex	Mean age	3-year discipline	4-year discipline	Total
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Male	22.98±2.50	129(20.00)	141(21.90)	270(41.90)
Female	21.10±2.01	187(29.00)	187(29.00)	374(58.10)
Total	21.88±2.41	316(49.10)	328(50.90)	644(100.00)

## 2. COVID-19 Stress Among the Students

Subfactors of the CSSK scores (fear of infection, social distancing, and anger) were compared by discipline and gender. In the three-year college students, there were statistically significant differences by gender in three subfactors: fear of infection ( $p<0.001$ ), social distancing ( $p<0.01$ ), and anger ( $p<0.01$ ); male students reported higher levels of COVID-19 stress than female students (Table 2). In the four-year college students, there were statistically significant differences in the two subfactors by gender: social distancing ( $p<0.001$ ) and anger ( $p<0.01$ ), but not fear of infection; males reported higher levels of COVID-19 stress than females (Table 2).

**Table 2. Differences in COVID-19 stress by discipline and gender**

Discipline	Variables	Gender	n	Mean	SD	t	p
3	Fear of infection	Male	129	3.37	1.11	4.839	0.000
		Female	187	2.82	0.91		
	Social distancing	Male	129	3.77	0.85	2.96	0.003
		Female	187	3.49	0.78		
	Anger	Male	129	2.91	1.06	3.358	0.001
		Female	187	2.55	0.87		
4	Fear of infection	Male	141	3.71	0.93	1.789	0.075
		Female	187	3.53	0.80		
	Social distancing	Male	141	3.29	0.97	4.445	0.000
		Female	187	2.83	0.90		
	Anger	Male	141	3.12	0.99	4.921	0.001
		Female	187	2.60	0.92		

## 3. Differences in COVID-19 stress by grade

The three subfactors of the CSSK scores were compared by grade. Among the sub-factors, there were no statistically significant differences in fear of infection and anger, but there were statistically significant differences in social distancing ( $p<0.01$ ). Post hoc tests showed differences in the stress degree regarding difficulties with social distancing among the top, upper-middle, and lower grades. Students with the highest grades had the highest levels of social distancing stress, while students with the lowest grades had the lowest levels of social distancing stress.

**Table 3. Differences in COVID-19 stress by grade**

CSSK	Grade	n	M	SD	F	p	Post hoc
Fear of infection	Upper	117	3.25	1.07	2.020	0.090	
	Middle-upper	146	3.01	0.95			
	Middle	200	2.99	0.95			
	Middle-lower	121	2.90	1.00			
	Lower	60	3.09	1.09			
	Total	644	3.03	1.00			
Social distancing	Upper <sup>a</sup>	117	3.82	0.87	3.179	0.013	b,c,d,e >a,c,e
	Middle-upper <sup>b</sup>	146	3.51	0.82			
	Middle <sup>c</sup>	200	3.60	0.83			
	Middle-lower <sup>d</sup>	121	3.49	0.83			
	Lower <sup>e</sup>	60	3.68	0.85			
	Total	644	3.61	0.84			

Anger	Upper	117	2.88	1.11	0.879	0.476
	Middle-upper	146	2.69	0.87		
	Middle	200	2.70	1.00		
	Middle-lower	121	2.80	0.93		
	Lower	60	2.82	0.97		
	Total	644	2.76	0.98		

**CSSK; COVID-19 Stress Scale for Korean People**

**4. Differences in SDL ability subfactors by discipline and gender**

SDL ability subfactors (SDL plan, SDL execution, and SDLevaluation) were compared according to college discipline system and gender. In three-year-old college students, there were no gender differences in any of the three subfactors: SDL planning, SDL execution, and SDL evaluation. Among the four-year college students, three sub-factors were statistically significant in SDLevaluation (p<0.022), but there was no gender difference in SDL planning and learning evaluation. SDL execution was higher among male than female students (Table 4).

**Table 4. Differences in subfactors of SDL ability by discipline and gender**

Discipline	Variables	Gender	n	M	SD	t	p
3	Learning plan	Male	129	2.76	0.77	1.206	0.229
		Female	187	2.66	0.77		
	Learning execution	Male	129	2.03	0.71	1.183	0.238
		Female	187	1.93	0.68		
	Learning evaluation	Male	129	2.57	0.72	-.556	0.578
		Female	187	2.62	0.75		
4	Learning plan	Male	141	2.69	0.77	1.789	0.075
		Female	187	2.55	0.64		
	Learning execution	Male	141	2.07	0.76	2.229	0.022
		Female	187	1.88	0.69		
	Learning evaluation	Male	141	2.59	0.78	1.069	0.286
		Female	187	2.50	0.72		

**5. The effect of SDL ability on grades**

To examine SDL ability's effect on grades, those of the five levels were classified as "excellent grade=1" for the upper and middle-upper grades, "poor grade=2" for lower-middle grades, and the fair grade=3 was set as the reference variable (Table 4).

The SDL evaluation factor was found to be significant in students with excellent grades, and if the SDLevaluation was not performed well, grades dropped 0.761 times (OR=.761). The SDL evaluation factor was significant even for students with poor grades. If the SDLevaluation was performed well, grades improved 1.379 times (OR=1.379).

**Table 5. Self- directed learning ability and grades by multinomial logistic analysis**

Self- directed learning	B	SE	OR	95% CI		Wald	p	
				Low	High			
Excellent grade	Plan	-0.106	0.127	0.900	0.702	1.153	0.698	0.404
	Execution	-0.062	0.122	0.940	0.740	1.194	0.257	0.612
	Evaluation	-0.273	0.125	0.761	0.595	0.973	4.749	0.029
Poor grade	Plan	0.240	0.137	1.271	0.971	1.662	3.054	0.081
	Execution	0.035	0.122	1.035	0.815	1.315	0.080	0.777
	Evaluation	0.322	0.135	1.379	1.058	1.798	5.660	0.017

Cox & Snell R<sup>2</sup>=0.106, Nagelkerke R<sup>2</sup>=0.119, McFadden R<sup>2</sup>=0.051

**DISCUSSION**

COVID-19 has affected all generations worldwide. Students were restricted from outside activities and had to become accustomed to non-face-to-face learning, which is a departure from previous learning methods. Rather than a conventional learning environment where there is a certain amount of control and instruction by the professor, it was a situation where the student's own will and control were linked to the learning outcome. Self-regulation of learning was required (Alt et al. 2023). This study aimed to investigate the performance of university students under COVID-19 stress and the relationship between SDL ability and academic performance.

Gender differences in COVID-19 stress were found in the subfactors of fear of infection ( $p < 0.001$ ), social distancing ( $p < 0.01$ ), and anger ( $p < 0.01$ ), and male students reported higher levels of COVID-19 stress than female students. In particular, among students at four-year colleges, male students scored higher than female students on social distancing ( $p < 0.001$ ) and anger ( $p < 0.01$ ). Specifically, male students scored higher than female students on the social distancing ( $p < 0.001$ ) and anger factors ( $p < 0.01$ ). Among college students in China in 2021, male students had higher levels of anxiety and depressive disorders than female students during the COVID-19 pandemic (Chang et al. 2021b). Gao et al. and Luo et al. also found that male students had higher levels of anxiety and depressive disorders than female students (Gao et al. 2020; Luo et al. 2021). Higher levels of stress among male students are associated with higher expectations of academic performance in Chinese society (Chang et al. 2021b). In South Korea, traditionally high expectations for male social roles and the fact that male students are more active than female students may have contributed to higher levels of COVID-19 stress among male students.

The highest level of COVID-19 stress experienced by upper-grade students was social distancing. In South Korea, national restrictions on social distancing are strictly enforced. In general, upper-grade students are characterized by superior SDL ability and high conscientiousness, and it is likely that they experienced the highest levels of social distancing stress because they were restricted from taking initiative based on their own judgement in SDL. When learners are given the opportunity to choose, control, and regulate their learning processes, considering their self-motivation, they can gradually develop into active rather than passive learners with SDL abilities (Kim et al. 2010). By contrast, students in the lower and middle grades had the lowest levels of social distancing stress during COVID-19 stress. This relates to a study that found that passive participants in a non-face-to-face learning situation also scored the lowest regarding SDL (Bae & Hwang 2021). In addition, it is believed that students in the lower grades, who lack initiative and conscientiousness, did not experience higher levels of social distancing stress during COVID-19 because they were able to stay at home for longer periods without space constraints, had fewer time constraints in attending classes, and could learn without compromising their learning attitudes.

South Korea implemented a robust social distancing campaign during the COVID-19 pandemic with national behavioral guidelines, including guidelines for individual behavior in the workplace and guidelines for employers. Among them, the National Action Guidelines included six tips: first, postpone or cancel non-essential outings, gatherings, meals out, events, and travel; second, stay home and achieve sufficient rest if you have a fever or respiratory symptoms (cough, sore throat, muscle aches, etc.); and third, avoid going out except to buy necessities, visit a healthcare provider, and commute to work; fourth, avoid physical contact with others, such as shaking hands, and maintain a 2-metre distance; fifth, follow personal hygiene practices such as handwashing and cough etiquette; and sixth, disinfect and ventilate the environment daily (Welfare 2020). These social distancing campaigns have impacted the overall lives of South Koreans, and seem to have had a major impact on the lives of college students.

Here, SDL ability was classified into three sub-factors— SDL planning, SDL execution, SDLevaluation—and a logistic regression analysis was conducted to examine the effects of the sub-factors on grades. The results showed no effect of SDL planning or execution on grades. In the SDL evaluation, students with excellent grades had an academic performance decline of 0.761 points if they did not perform well on the SDL evaluation. By contrast, students with poor grades improved their grades 1.379 times ( $OR = 1.379$ ) when their SDL evaluation was positive. Therefore, among SDL abilities under COVID-19 conditions, the SDL evaluation appears to have the greatest influence on students' academic performance. In a study of students in South Africa, Singaram et al. (Singaram et al. 2022) found that personal characteristics such as reflection, self-determination, motivation, resilience, positive learning behaviors, and skills enabled SDL. Knowles (Knowles 1975) defined SDL

as "a process in which individuals take the initiative without the assistance of others in diagnosing their learning needs, setting goals, identifying human and material resources, and evaluating learning outcomes." Based on the definition of SDL, the main characteristic of SDL is that the learner completes the learning process without third-party interference. SDL motivates learners and creates responsibility for taking control of learning situations by identifying their learning needs. SDL evaluation is a specific method for realizing SDL (Jeon 2011) and includes causal behavior and self-reflection ability. The greatest benefit of conducting SDLevaluations is the opportunity to engage in autonomous learning, which gives learners the chance to think and reflect on their readiness, conscientiousness, motivation to learn, and relationships with other learners (Jeon 2011). SDL evaluation is emerging as an important factor in academic achievement during the COVID-19 pandemic.

As this study targeted only college students majoring in physical therapy, applying the results to college students majoring in all health professions could be problematic. This study also only examined SDL and lacked a comparative review of the various factors affecting academic performance.

## CONCLUSIONS

This study examined the relationship between SDL ability and academic performance of college students during the COVID-19 pandemic. Male students had higher levels of COVID-19 stress than female students, and social distancing stress was the highest among students in the highest grades and lowest among those in the lowest grades. Therefore, COVID-19 affected the grades of college students.

Additionally, students with excellent grades decreased their grades by 0.761 times (OR=.761) if their SDL evaluation was poor, and students with poor grades increased their grades by 1.379 times (OR=1.379) if their SDL evaluation was good. Therefore, among the SDL abilities during the COVID-19 pandemic, SDL evaluation had the greatest influence on the grades of students with excellent and poor grades.

The findings of this research provide a foundation for enhancing the academic performance of college students in a pandemic scenario akin to that of COVID-19.

## Authors' Contributions

Roh conceived the idea, designed the project and wrote the manuscript. Park participated in the design of the study and data collection was done. All authors read and approved the final manuscript.

## ACKNOWLEDGEMENTS

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