

## Article

# Technical College Students' Practical Performance Anxiety during Online Learning: Difference in Gender and Average Time of Online Learning

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**Abstract:** The person-artifact-task model provided us with a method to consider the practical performance anxiety (PPA) of technical college students who were working on a computer-related task via online learning. This study investigated 474 technical college students' PPA in online courses without hands-on demonstration (PPAOC-without-HD) and with hands-on demonstration (PPAOC-with-HD), and it explored whether their PPA varied according to gender and average time spent on online learning. The results indicated that the students' two types of PPA (PPAOC-without-HD and PPAOC-with-HD) varied significantly by gender and across the different online learning time groups. The average levels of participants' two types of PPA were both high, and their PPAOC-without-HD was higher than their PPAOC-with-HD. Both types of PPA for females were significantly higher than those for males. Participants' PPAOC-with-HD showed a significant difference for the average time of online learning. The findings of this study will be of value to educators who need to design and carry out online learning courses for technical college students.

**Keywords:** practical performance anxiety; online learning; hands-on demonstration; gender difference; engineering education; average time of online learning; learning anxiety



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## 1. Introduction

Many schools around the world had to conduct online distance education to ensure that students' schooling was not interrupted during the COVID-19 epidemic. The combination of online and offline forms of teaching and learning will be a product of the profound impact of the pandemic on the education system, and it may become a new form of teaching and learning during future pandemics [1]. Rapid digitalization and emergency remote teaching practices, the potential learning and teaching risks that we were exposed to during the COVID-19 pandemic, have made inclusive and equitable education a global priority [2,3]. However, many educators tended to be unprepared for online delivery, and students had reduced access to digital technology and stable and reliable internet. This likely affected low socioeconomic and vulnerable student populations the most, failing to uphold Goal 4 of inclusive and accessible education for all. Changes in the learning environment (e.g., the transition from face-to-face learning to online learning) can influence students' well-being, behaviors, and learning [4,5]. For example, the transition from face-to-face learning to online learning led to higher learning anxiety among students [6]. Moreover, students who study online experience higher levels of anxiety than students who study offline [7,8].

Emergency remote teaching has a certain degree of interference and inconvenience for college students who need hands-on practice, such as a lack of hardware equipment and the weakness of internet signals. It may be easier for those students to feel anxious about their practical performance in the future. In practical education, students' manual performance

is an important factor to evaluate their vocational skills, in which the quality or safety of manual artifacts is required to meet basic professional standards [9]. However, in the online learning context, students and instructors are separated in different physical spaces, and students cannot conduct on-site operation in a laboratory. Especially for technical college students, developing vocational skills is the main goal of their study. Some learning and practice activities of students can only be carried out in special laboratories or with the help of special equipment. Thus, the implementation of practical courses or related courses was greatly limited due to the lack of some specific learning tools. Learners who have to master manual skills may experience practical performance anxiety (PPA). It is therefore beneficial for online educators to design online teaching activities adapted to learning objectives for students who need to receive practical skills training.

The person-artifact-task (PAT) model proposed by [10] is used to conceptualize the main component of a person working on a computer-related task. According to the PAT model, the learning process of students will trigger a series of emotional reactions and behavioral differences, resulting in different learning outcomes [11]. Similarly, some studies [12,13] have indicated that PPA makes a negative contribution to learners' manual performance in practical courses. Therefore, it is necessary to investigate the PPA of technical college students. However, although prior studies have focused on online learning students' self-efficacy [14], learning motivation [14,15], learning performance [16], and learning satisfaction [17], there is little research that has focused on students' practical performance anxiety (PPA) in online learning environments [12]. The anxiety that this study investigates is students' perceived practical performance anxiety about the need for hands-on practice in face-to-face courses after the school resumes operation in the future. With the development of information technology, some practical demonstrations can use live-transmitted hands-on demonstration videos, and prerecorded procedural videos to present specific operating procedures. However, these methods reduce the direct contact between teachers and students, and also lead to the possibility of the loss of fruitful discussion compared with the live demonstration teaching approach [18]. Schlafer et al., (2021) [18] also found that procedural videos that capture all aspects of a teacher's processing in high definition can help in the classroom. Thus, this study proposed two types of practical performance anxiety: practical performance anxiety in online courses without hands-on demonstration (PPAOC-without-HD) and practical performance anxiety in online courses with hands-on demonstration (PPAOC-with-HD).

E-learning tools are influencing learning ways in the digital era, and reassessing learners' mindsets can help improve student learning outcomes [19]. For college students who need to complete complicated tasks by hands-on practice, it is very important for instructors to know the students' PPA difference during online learning. Therefore, this study attempted to explore the anxiety that college students taking online classes feel about future offline hands-on classes during the epidemic prevention and control period after receiving theoretical courses with hands-on demonstration and theoretical courses without hands-on demonstration. In addition, Faura-Martínez et al., (2021) [20] found it difficult for students to follow the course online, spent more hours per day studying, and achieved lower academic performance. During the COVID-19 pandemic, Alismaiel et al., (2021) [21] also found that students' attitudes on social media have a positive influence on their academic performance. Thus, this study also aimed to map out the differences about the two types of practical performance anxiety (PPAOC-without-HD and PPAOC-with-HD) according to gender and online learning time. The conclusions of this study would be helpful to evaluate students' learning performance in online courses under the epidemic lockdown and can be a valuable reference for educators.

## 2. Literature Review

### 2.1. Practical Performance Anxiety

In the online environment, anxiety is an unpleasant emotion and one of the most frequent and intense academic emotions [22,23]. In traditional learning environments,

high levels of anxiety lead to learners' lower interest, reduced intrinsic motivation, and impaired learning performance [24–26]. Similarly, the higher the level of anxiety, the lower the intention to persist with online learning [27,28]. Therefore, anxiety may affect the behavioral performance of online learners to some extent. Processing Efficiency Theory (PET) explains how anxiety affects performance [29]. The cognitive dimension of anxiety includes symptoms of impaired attention and the negative effects associated with distorted thought processes, whereby cognitive symptomology of anxiety will reduce attentional resources and make attention-control tasks more difficult [29,30]. Specifically, when an individual is threatened, people in a state of anxiety try to allocate their attention to identify the source of the threat, which in turn reduces their performance [29]. In the somatic dimension, anxiety is described as self-reported physiological symptoms, such as hyperchromatic and heart palpitations [30]. In medicine, performance anxiety (PA) is used to describe a physician's anxiety during surgery [31]. During their training, surgical specialty trainees need to conduct multiple surgical training sessions and accumulate operative experience to cope with future surgeries without guidance. During operations, interns often feel anxiety; this kind of anxiety is called PA [31]. Based on PA theory, this study proposes PPA, which is practical performance anxiety. PA was introduced into online learning to explore how students receiving online courses feel about their PPA in face-to-face learning courses in the future, which is conducive to a deeper understanding of students' learning performance.

A prior study indicated that online students with low technical ability were more likely to have emotions and anxiety when they encountered technical problems [32]. Referring to the PET and PA theory, this study aimed to discuss the practical performance anxiety of students who received online learning at home in the context of the pandemic lockdown. In line with this, considering that there were some theoretical courses where the teacher provided demonstrations whereas some of them did not, this study divides practical performance anxiety into two types: PPAOC-without-HD and PPAOC-with-HD. This paper aims to investigate the students' PPAOC-without-HD and their PPAOC-with-HD, and the differences in terms of gender and average time spent on online learning.

## 2.2. *Influencing Factors of PPA in Online Learning: Gender and Online Learning Time*

### 2.2.1. Gender

Males performed better than females in hands-on activities in some areas. For instance, in introductory and advanced Geology courses for undergraduates, male students performed significantly better than female students in terms of spatial skills after hands-on training interventions [33]. Furthermore, men have been found to perform better than women in science, engineering, mathematics, and technology [33–36].

Gender may have a substantial impact on an individual's cognitive functions such as perception, memory, and emotion [37]. Considering the differences in males' and females' hands-on skills, females may have more PPA than males. In addition, PPA may be magnified when students face a considerable amount of uncertainty in the online learning environment due to the COVID-19 epidemic. Previous studies have focused on gender differences in traditional face-to-face learning, but there are few empirical studies on gender differences in online learning [38]. The results related to the gender difference in online learning did not reach a consistent conclusion [38]. For example, some studies found that gender has no significant influence on students' anxiety in online learning [39] and online learning performance [16], whereas the research results of [40] suggested that gender had a significant influence on students' online learning outcomes. Thus, whether there is a difference in practical performance anxiety between male and female students in online learning environments needs to be further explored. In this study, gender was used as a dependent variable to compare whether there were significant differences between male and female students' PPAOC-without-HD and PPAOC-with-HD in online learning environments.

### 2.2.2. Average Time of Online Learning

Student participation in the classroom, whether face-to-face or online, is a key factor of academic success [41]. Engagement consists of both the willingness to participate in activities and the time spent on learning tasks [42]. To observe the level of engagement generated by the use of technology in learning, the time spent on the task can be used to evaluate student engagement [43,44]. In addition, [45] students' learning engagement can be measured by the number of posts to forums, the number of quizzes taken, the number of lecture videos watched, and the number of tasks completed. In the online learning process, it is difficult for instructors to directly observe the performance of students due to the separate locations. In addition to the students' online learning behaviors, students' cognitive and emotional dimensions are also difficult to describe. Considering that different universities and instructors chose different online learning platforms during the pandemic lockdown, some data such as the number of lecture videos watched by students could not be collected or were difficult to collect. Based on the above viewpoints and under the guidance of learning engagement theory, this study adopted the average online learning time of learners as an important observation index to explore whether students' two types of PPA would show differences according to different online learning times.

Anxiety is a negative academic emotion that may hinder students' learning engagement [46]. Furthermore, long-term online teaching is not conducive to students' physical and mental health [47]. Therefore, this study takes the students' average time of online learning as an independent variable and explores its relationship with PPA. Specifically, the current study explored whether students' PPAOC-without-HD and PPAOC-with-HD would change according to their average time of online learning.

### 2.3. Purpose of the Study

The person-artifact-task model provided us with a method to consider the practical performance anxiety of the students who were working on a computer-related task via online learning. The present study aimed to investigate the role of gender differences in generating PPAOC-without-HD and PPAOC-with-HD in an online learning environment. This study explored whether the average time for which students received online learning could have a different influence on their PPAOC-without-HD and PPAOC-with-HD. In addition. To achieve the research purpose, three research questions were proposed as follows:

RQ1: What are the levels of college students' PPAOC-without-HD and PPAOC-with-HD?

RQ2: Are there significant differences in PPAOC-without-HD in terms of gender and online learning time?

RQ3: Are there significant differences in PPAOC-with-HD in terms of gender and online learning time?

## 3. Methods

### 3.1. Data Collection and Participants

Data were collected by purposive sampling during the COVID-19 lockdown period of 1–10 April 2020. Before that time, students had been studying online for nearly a month. An online free survey tool called Questionnaire Star ([www.wjx.cn](http://www.wjx.cn) accessed on 5 June 2022) was used to send the questionnaire. The first part of the questionnaire was the informed consent statement. Responders were told that they would fill in the questionnaire anonymously and voluntarily. If they did not want to participate in the survey, they could quit the questionnaire web page. If they were willing to answer each item of the questionnaire, which meant they agreed to participate in the survey, their information would be kept by the researchers for a study which may be published in the future. However, nobody else would get the data for any commercial or any other use. Since it was an anonymous survey, their answers would not be related to their academic scores. Of the 527 returned questionnaires, 53 were deleted due to incomplete information, erroneous codes, or participants without online courses. Thus, the remaining 474 valid questionnaires

were used for further data analysis. The respondents who were invited to participate in this survey had different undergraduate backgrounds, ranging from environmental engineering technology, communication engineering, to electronic information engineering. 474 participating college students consisted of 226 (47.7%) males and 248 (52.3%) females. As for the time that students spent on online learning, 64 (13.5%) spent 2 h or less, 252 (53.2%) spent 2–4 h, 107 (22.6%) spent 4–6 h, and 51 (10.8%) spent 6 h or above.

### 3.2. Instruments

The questionnaire used in this study was divided into two parts. The first part was used to collect the respondents' demographic information, such as gender and average time spent on online learning. The second part of the questionnaire was used to measure students' two types of practical performance anxiety. Responses were rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). To ensure the content validity and face validity of the questionnaire, three experts in educational technology were invited to review all items and give feedback. The research team compared the similarities and differences in expert opinions and made joint decisions. Then, three college students were invited to conduct a telephone interview, in which they were asked to interpret each item and express their opinions on the complexity of the item and where the statement was unclear. Descriptions of these two instruments are provided below.

#### 3.2.1. The Scale of Practical Performance Anxiety in Online Courses without Hands-on Demonstration (PPAOC-without-HD)

PPAOC-without-HD measures students' perceived practical performance anxiety in an online learning course where the instructor teaches theory without any practice demonstration. There were seven items to measure students' PPAOC-without-HD. The scale of PPAOC-without-HD was revised from Gustad et al. (2005) [48] and the Achievement Emotions Questionnaire [49]. Sample items of the PPAOC-without-HD are: If the instructor only teaches theory in online learning, I will worry about not performing well when I do hands-on exercises in practical lessons in the future; and, Although I have basically mastered the knowledge received in online theory classes, I will feel panicked when I think I need to do hands-on practice in the future.

#### 3.2.2. The Scale of Practical Performance Anxiety in Online Courses with Hands-on Demonstration (PPAOC-with-HD)

PPAOC-with-HD measures students' perceived practical performance anxiety in an online learning course where the instructor provides demonstration. PPAOC-with-HD was measured by seven items. These items were adapted from Gustad et al., (2005) [48] and the Achievement Emotions Questionnaire [49]. Sample items of the PPAOC-with-HD are: I still have no confidence in the future practical class even if the instructor provides demonstration in online courses; and, Although the instructor has fully demonstrated the operation steps in an online course, I will still be flustered when it comes to hands-on operation in future practical lessons.

### 3.3. Reliability and Validity Analysis

In the present study, SPSS (version 20.0, IBM, Armonk, NY, USA) and AMOS (version 22.0, IBM, Chicago, IL, USA) were used to conduct the internal consistency test and the confirmatory factor analysis (CFA) to ensure the reliability and validity of the instrument. Previous research suggested that the Goodness of Fit Index (GFI), Normed Fit Index (NFI), and Comparative Fit Index (CFI) values should be above 0.8 [50,51], Chi-square/*df* ( $\chi^2/df$ ) should be below 5.0 [51], and Root Mean Square Error of Approximation (RMSEA) should be less than 0.08 [51] for the measurement model to fit the data well. CFA results indicated that the instrument of PPAOC-without-HD ( $\chi^2/df = 3.618$ ; GFI = 0.993; NFI = 0.990; CFI = 0.993; RMSEA = 0.074) and PPAOC-with-HD ( $\chi^2/df = 3.172$ ; GFI = 0.993; NFI = 0.995; CFI = 0.996; RMSEA = 0.068) had acceptable validity. The scales of PPAOC-without-HD and PPAOC-with-HD each retained four items after first-order confirmatory factor analysis.

The standardized factor loading of each item exceeded 0.50 (i.e., PPAOC-without-HD: 0.698–0.821; PPAOC-with-HD: 0.721–0.900), and the average variance extracted (AVE) of PPAOC-without-HD (0.560) and PPAOC-with-HD (0.703) was greater than 0.50, which indicates that the measurement tool has acceptable convergent validity [52]. Moreover, the Cronbach's alphas of the PPAOC-without-HD and the PPAOC-with-HD were calculated as 0.834 and 0.901, respectively, which indicated that the questionnaire had high internal consistency.

### 3.4. Data Analysis

Descriptive and inferential statistics were calculated to analyze the questionnaire data. Means and standard deviations were first used to assess the students' overall PPAOC-without-HD and PPAOC-with-HD. Then, multivariate analysis of variance (MANOVA) was conducted to test whether there were significant differences in PPAOC-without-HD and PPAOC-with-HD between the male and female students and among the different online learning times. The independent variables (IVs) were gender and online learning time, and the dependent variables (DVs) were the two types of PPA. In addition, the interaction effects of the three independent variables were also analyzed. When the  $p$  value of average time of online learning is significant, a Post Hoc test using Least Significance Differences (LSD) should be conducted for cross-comparisons to determine where the differences lie. The strength of the relationship between independent variables and the dependent variables was measured by calculating the effect size represented by partial eta squared ( $\eta_p^2$ ).

## 4. Results

### 4.1. Overall Level of PPAOC-without-HD and PPAOC-with-HD for College Students in Online Learning

According to the criteria of Dupley et al., (2020) [31] for the evaluation of anxiety level, in this study, the mean value of PPAOC-without-HD or PPAOC-with-HD greater than 9.6 is considered as a high anxiety level, 6.8 to 9.6 is medium anxiety, and less than 6.8 is low anxiety. In total, 412 respondents scored  $>9.6$  (86.9%) for PPAOC-without-HD, suggesting high levels of anxiety. A total of 60 respondents (12.7%) scored 6.8–9.6, suggesting medium levels of anxiety. Only two respondents (0.4%) scored less than 6.8, indicating low levels of anxiety. In terms of PPAOC-with-HD, 356 (75.1%), 89 (18.8%), and 29 (6.1%) respondents scored  $>9.6$ , 6.8–9.6, and  $<6.8$ , respectively. Therefore, more than half of the students reported the low levels of PPAOC-without-HD and PPAOC-with-HD.

Students' descriptive results for the overall PPAOC-without-HD and PPAOC-with-HD dimensions are given in Table 1. According to the results, the students reported the highest mean ( $M = 12.81$ ,  $SD = 2.39$ ) for PPAOC-without-HD, followed by PPAOC-with-HD ( $M = 11.99$ ,  $SD = 3.04$ ). As for gender, the highest mean was seen for females in the dimensions of PPAOC-without-HD ( $M = 13.32$ ,  $SD = 2.58$ ) and PPAOC-with-HD ( $M = 12.42$ ,  $SD = 3.25$ ). In terms of students' average time of online learning, it was found that students who spent an average of less than 2 h on online learning had the highest mean in PPAOC-without-HD ( $M = 13.72$ ,  $SD = 2.24$ ) and PPAOC-with-HD ( $M = 13.02$ ,  $SD = 2.70$ ). Those who spent more than 6 h on online courses had the lowest PPAOC-without-HD ( $M = 11.76$ ,  $SD = 3.52$ ) and PPAOC-with-HD ( $M = 10.67$ ,  $SD = 3.04$ ).

### 4.2. Differences in PPAOC-without-HD and PPAOC-with-HD in Terms of Gender and Online Learning Time

In order to check the equality of covariance, Box's test was performed. The results showed that there was no significance (Box's  $M = 16.588$ ,  $F = 0.678$ ,  $p = 0.872 > 0.05$ ), indicating that covariance values were equal between groups and the criteria were met for performing MANOVA [53]. Then, Levene's Test was conducted for each variable to define the homogeneity of variances, and the results indicated that the variances were homogeneous between the dimension PPAOC-without-HD ( $F = 1.240$ ,  $p = 0.257 > 0.05$ ) and

PPAOC-with-HD ( $F = 1.332, p = 0.173 > 0.05$ ). Thus, Wilk's Lambda ( $\lambda$ ) test was conducted due to the variances being homogeneous.

**Table 1.** Overall PPAOC-without-HD and PPAOC-with-HD by different genders and online learning times.

Variables		N (%)	PPAOC-without-HD M (SD)	PPAOC-with-HD M (SD)
Gender	Male	226 (47.7)	12.24 (2.05)	11.51 (2.71)
	Female	248 (52.3)	13.32 (2.58)	12.42 (3.25)
Average time of online learning	≤2 h	64 (13.5)	13.72 (2.24)	13.02 (2.70)
	2–4 h	252 (53.2)	12.84 (2.11)	12.27 (2.74)
	4–6 h	107 (22.6)	12.70 (2.25)	11.35 (3.21)
	≥6 h	51 (10.8)	11.76 (3.52)	10.67 (3.76)
Overall		474	12.81 (2.39)	11.99 (3.04)

According to the MANOVA results, the combined dependent variables were significantly related to gender (Wilks'  $\lambda = 0.960, F = 19.803, p = 0.000, \eta_p^2 = 0.040$ ) and average time of online learning (Wilks'  $\lambda = 0.976, F = 11.235, p = 0.011, \eta_p^2 = 0.024$ ). The combined dependent variables were insignificantly related to  $\eta_p^2$  for the interaction between gender and average time of online learning (Wilks'  $\lambda = 0.996, F = 1.711, p = 0.789, \eta_p^2 = 0.004$ ). The multivariate partial Eta squared ( $\eta_p^2$ ) was used to access the association between independent variables and combined independent variables. When the value of  $\eta_p^2$  is 0.01, 0.06, and 0.14, it is considered as a small effect, a moderate effect, and a large effect, respectively [54]. Therefore,  $\eta_p^2 = 0.040$  demonstrates that approximately 4.0% of the multivariate variance of the dependent variable was moderately associated with gender. Similarly, 2.4% was moderately associated with average time of online learning. After significant MANOVA results were obtained, follow-up ANOVAs on the PPAOC-without-HD and PPAOC-with-HD were administered.

#### 4.3. Gender

As shown in Table 2, the male and female learners who spent 2–4 h per day on online learning were the most, at 63.71% and 46.9%, respectively. The male and female learners who spent 4–6 h a day on online study was also relatively high, with 16.94% and 28.76% respectively.

**Table 2.** Average online learning time per day for male and female learners.

Gender	≤2 h	2–4 h	4–6 h	≥6 h
Male	32 (14.16%)	106 (46.90%)	65 (28.76%)	23 (10.18%)
Female	33 (13.31%)	158 (63.71%)	42 (16.94%)	15 (6.05%)

Follow-up univariate ANOVAs with gender as the independent variable were used to determine the significance of PPAOC-without-HD and PPAOC-with-HD. As presented in Table 3, the result indicated that gender differences were significant in the students' PPAOC-without-HD ( $F = 25.350, p = 0.000, \eta_p^2 = 0.051$ ) and PPAOC-with-HD ( $F = 10.739, p = 0.001, \eta_p^2 = 0.022$ ). The relation of gender and PPAOC-with-HD reached a significant level, and the effect size was moderate ( $\eta_p^2 > 0.006$ ), demonstrating a modest association between gender and PPAOC-with-HD. Similarly, gender had a modest association with PPAOC-without-HD.

**Table 3.** Tests of between-subjects effects for gender.

Independent Variable	Dependent Variable	F	Sig.	$\eta_p^2$
Gender	PPAOC-without-HD	25.350	0.000	0.051
	PPAOC-with-HD	10.739	0.001	0.022

#### 4.4. Average Time of Online Learning

The ANOVA results for average time of online learning are shown in Table 4. Among the PPAOC-without-HD and PPAOC-with-HD, significant differences were only found for PPAOC-with-HD ( $F = 3.717$ ,  $p = 0.012$ ,  $\eta_p^2 = 0.024$ ), and the small effect size ( $\eta_p^2 < 0.06$ ) indicated that the associations between average time of online learning and PPAOC-with-HD were not strong. The result of the post-hoc comparisons are provided in Table 5. PPAOC-without-HD of students who spent less than 2 h on online learning was higher than that of those who spent 2–4 h, 4–6 h, and more than 6 h. Moreover, the students studying 2–4 h had a higher mean than the students studying more than 6 h for the PPAOC-without-HD dimension. For the PPAOC-with-HD dimension, students who spent less than 2 h on online learning had a higher mean than those who spent 4–6 h and more than 6 h. In addition, the students studying 2–4 h had a higher mean than the students studying 4–6 h and more than 6 h for the PPAOC-with-HD dimension, whereas the other groups did not differ significantly from each other.

**Table 4.** Tests of between-subjects effects for average time of online learning.

Independent Variable	Dependent Variable	F	Sig.	$\eta_p^2$
Online learning time	PPAOC-without-HD	1.077	0.359	0.007
	PPAOC-with-HD	3.717	0.012	0.024

**Table 5.** Multiple comparisons for average time of online learning.

	Online Learning Time		Mean Difference (I, J)	Sig.
PPAOC-without-HD	≤2 h (I)	2–4 h (J)	0.878 *	0.025
	≤2 h (I)	4–6 h (J)	1.018 *	0.020
	≤2 h (I)	≥6.1 h (J)	1.954 *	0.000
	2–4 h (I)	4–6 h (J)	0.140	0.947
	2–4 h (I)	≥6 h (J)	1.077 *	0.009
	4–6 h (I)	≥6 h (J)	0.936	0.063
PPAOC-with-HD	≤2 h (I)	2–4 h (J)	0.750	0.228
	≤2 h (I)	4–6 h (J)	1.670 *	0.001
	≤2 h (I)	≥6 h (J)	2.349 *	0.000
	2–4 h (I)	4–6 h (J)	0.920 *	0.025
	2–4 h (I)	≥6 h (J)	1.600 *	0.001
	4–6 h (I)	≥6 h (J)	0.680	0.488

\* The mean difference is significant at the 0.05 level.

## 5. Discussion

The purpose of this study was to investigate the anxiety of college students about future hands-on courses during online learning under the epidemic lockdown, in the hope of helping to understand the online learning situation of college students more broadly and to shed light on pedagogy. Two types of practical performance anxiety (PPAOC-without-HD and PPAOC-with-HD) were introduced in this study, and it was discussed whether there were differences between these two types of anxiety in terms of students' gender and average daily online learning time.

The findings suggested that half of the students showed a high level of PPAOC-without-HD and PPAOC-with-HD for online learning under the COVID-19 lockdown, and

students' PPAOC-without-HD was higher than their PPAOC-with-HD. College students' PPAOC-without-HD and PPAOC-with-HD showed significant differences by gender. The females' PPAOC-without-HD and PPAOC-with-HD were significantly lower than those of males. The students' PPAOC-with-HD varied significantly between the average time of online learning groups. Students with low online learning time had greater anxiety about future hands-on classes than those with long online learning time.

### *5.1. Overall Level of College Students' PPAOC-without-HD and PPAOC-with-HD in Online Learning*

More than half of the respondents reported low levels of PPAOC-without-HD and PPAOC-with-HD, whereas their PPAOC-without-HD level was higher than their PPAOC-with-HD level. In other words, students' practical performance anxiety in the online course focusing on demonstration was lower than that in the online course focusing on theoretical explanation but not demonstration. As for gender, the PPAOC-without-HD and PPAOC-with-HD of females were higher than those of males. As for the average time of online learning, students who spent more than 6 h had the lowest PPAOC-without-HD and PPAOC-with-HD, whereas students who spent less than 2 h had the highest PPAOC-without-HD and PPAOC-with-HD.

### *5.2. Females Have Higher Levels of PPAOC-without-HD and PPAOC-with-HD Than Males in Online Learning*

Gender-related differences were discovered in the students' PPAOC-without-HD and PPAOC-with-HD, and female students scored higher than males. This result is consistent with Wang and Zhao (2020) [6] and Riquelme et al. (2021) [55], who suggested that significant differences were found between all males and all females, and the females' anxiety level was higher than that of males. The possible reasons may be that males are better adapted to the transition from the traditional face-to-face learning environment to the online environment and show better learning performance [56,57]. Another reason may be that females have lower self-efficacy and a lower sense of belonging in the course than males when it comes to science, technology, engineering, and mathematics courses [34].

### *5.3. PPAOC-with-HD Varied Significantly among Average Time Students Received Online Learning*

Students' PPAOC-with-HD varied significantly among different groups divided by the average time the students spent on online learning ( $\leq 2$  h, 2–4 h, 4–6 h, and  $\geq 6$  h). PPAOC-with-HD of students with average online learning time of 2 h and 2.1–4 h was significantly higher than that of students with an average online learning time of 4.1–6 h, and students with an average online learning time of 2 h was significantly higher than that of students with an average online learning time of 6 h. Although no research has explored the differences in online learners' PPA in terms of the time they devote to online learning, the results of this study can be explained by some previous studies. As students move through their studies, if their emotional, cognitive, and behavioral states are not given appropriate stimulation and are not given enough time to mature, they will easily have negative social attitudes and be separated from themselves and the community [58]. Furthermore, in the learning environment, emotion plays an important role in the formation of individual perception and performance [59]. For example, the more time learners spend on online learning environment, the better academic performance they have [43]. Thus, the longer the time spent online, the better it may be for students to adapt to the change of learning environment and to become more engaged in learning, thus reducing the occurrence of bad emotions. In addition, although students' PPAOC-without-HD did not vary significantly among the average time students received online learning, students' PPAOC-without-HD level was higher than their PPAOC-with-HD level. Thus, instructors may conduct their practical process with demonstration to reduce students' PPA and enhance their learning performance during online learning.

## 6. Conclusions

In order to better understand technical college students' practical performance anxiety about future offline courses after experiencing online learning under the COVID-19 lockdown, two types of practical performance anxiety (PPAOC-without-HD and PPAOC-with-HD) were introduced in this study. This study also discussed whether there were differences between these two types of anxiety in terms of students' gender and average daily online learning time.

The findings suggested that half of the students showed a large level of PPAOC-without-HD and PPAOC-with-HD for online learning under the COVID-19 lockdown, and students' PPAOC-without-HD was higher than their PPAOC-with-HD. College students' PPAOC-without-HD and PPAOC-with-HD showed significant differences by gender. The females' PPAOC-without-HD and PPAOC-with-HD were significantly higher than those of males. The reason for the gender difference may be that males are more able to adapt to the change of learning environment than females [56,57]. In addition, males may have a higher sense of belonging and self-efficacy than females in practical courses [34]. The students' PPAOC-with-HD varied significantly between the average time of online learning groups. Students with low online learning time had greater anxiety about future hands-on classes than those with long online learning time. A previous study indicated that the longer learners are involved in online learning, the more they can adapt to the changes of learning environment [43]. In technical college, teachers can provide specific demonstrations to students if conditions permit, so as to reduce students' PPA.

This study contributes to the evidence of prior research on the effects of gender and the time of online learning on online students' anxiety. Moreover, the current study distinguished the two types of practical performance anxiety, that is practical performance anxiety in online courses without hands-on demonstration (PPAOC-without-HD) and practical performance anxiety in online courses with hands-on demonstration (PPAOC-with-HD). It is further confirmed that students' PPA was lower in the courses that provide demonstration than in the courses that do not provide demonstration.

It should be noted, however, that this study has several limitations. First, the data in this study were collected from a limited number of participating schools in a certain district by random sampling, making it difficult to generalize the results to all college groups in the world. A more diverse range of samples is recommended in a broader context to evaluate the findings of this study in the future. Second, the study was unable to establish a cause-and-effect relationship between online learning time and PPAOC-without-HD and PPAOC-with-HD because it was a cross-sectional study. Moreover, the participants had an unequal gender distribution. Although statistical methods were used to check statistical problems, there could have been an inflation of Type 1 errors. In light of the above limitations, future studies can further explore the influence of average time of online learning and gender on PPAOC-without-HD and PPAOC-with-HD through longitudinal studies or intervention studies, and even use qualitative research methods to enrich the data and findings. In addition, the relationship between the two types of anxiety (PPAOC-without-HD and PPAOC-with-HD) and academic performance can be explored in the future.

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