

# Factors Influencing Pre-Service Technical Teachers' Academic Performance: Cross-Sectional Study

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## Abstract

This research aims to identify factors predicting pre-service technical teachers' academic performance in a technical teacher training context. This study employed a predictive correlational design. We developed the conceptual framework by combining previous research, and then created a survey to gather data. Between August 1 and August 30, 2022, 109 undergraduates from the Faculty of Technical Education at Rajamangala University of Technology Krungthep (RMUTK) received an online self-administered questionnaire. The statistical analysis employed the Pearson correlation coefficient and multiple regression. The findings of the research showed that there was a positive correlation between various factors such as gender, motivation and attitude towards learning, study habits, family support, curriculum quality, and teaching quality with pre-service technical teachers' academic performance, with the correlation coefficients ranged from .230 to .292 and were all statistically significant ( $p < 0.05$ ). The multiple correlation coefficient ( $R$ ) was .474 showed a significant relationship between the independent and dependent variables at the .05 level. The R-squared value was .225, indicating that these six variables combined explain 22.5% of the variation in academic performance. However, this also suggests that our model fails to explain around 77.5% of the variance. Some aspects of the findings derived from this study are expected to result in the creation of digital interventions to better track students' academic performance, aiming to provide equitable educational experiences that maximize the academic performance of each gender group in the future.

**Keywords:** academic performance, individual level, interpersonal level, institutional level, pre-service technical teachers, teacher professional development

## 1. Introduction

Academic achievement, popularly called academic performance, is a measure of the results of learning in an educational institution (Steinmayr, Meißner, Weidinger, & Wirthwein, 2014; Mappadang, Khusaini, Sinaga, & Elizabeth, 2022). It reflects the student's capacity to assimilate and utilize acquired knowledge from education. Academic performance at the course level can be measured in many ways, such as test scores, performance evaluations, grades, or other educational activities, while at the program level, it is often measured through the grade point average (GPA) or by standardized assessments designed for selection purposes, such as the Scholastic Assessment Test (SAT), which determines whether a student will have the opportunity to continue education (e.g., to attend a university) or other criteria established by educational institutions or systems (Steinmayr, R., Meißner, A., Weidinger, A. F., & Wirthwein, 2014; Kappe & Van Der Flier 2012). The role of academic performance serves as a strong determinant of individual development, future employment opportunities, career path, future earnings, and socioeconomic advancement (Montolio & Taberner, 2021; Whipple & Dimitrova-Grajzl, 2021).

In the ecosystems of modern higher education institutions, they focus on objectives and key results (OKRs) to navigate the challenges and opportunities of the digital era (Wanmontree & Rangkoon, 2021; Benavides, Tamayo Arias, Arango Serna, Branch Bedoya, & Burgos, 2020; Cao, 2021). These OKRs are built upon four foundational pillars: 1) organizing digital learning and development; 2) advanced research and development; 3) academic consulting and service provision; and 4) the preservation of national arts and cultural heritage. Central to the

mission of Thai higher education institutions is the organization of learning and development programs, both degree-based and non-degree, to promote workforce competencies (Office of the Higher Education Commission, 2015; Denwattana & Saengsai, 2016; Bygstad, Øvrelid, Ludvigsen, & Dæhlen, 2022).

Rajamangala University of Technology Krungthep (RMUTK) is classified as a Thai university that emphasizes the development of technology and innovation (Ministry of Higher Education, Science, Research and Innovation, 2021). RMUTK, previously known as Krungthep Technical College, was founded in 1952 and enhanced to an accredited university in 2005 (Rajamangala University of Technology Krungthep, 2021; Times Higher Education, 2021). RMUTK produces hands-on technical teachers who meet the criteria established by the Thailand government's teacher training authorities. Since 2005, RMUTK's faculty of technical education has been responsible for training technical teachers. It is recognized as one of Thailand's top ten institutions for training technical educators (Faculty of Technical Education, 2021). A challenge faced by technical education faculty in the digital age is to effectively improve the academic performance of pre-service technical teachers through digital intervention.

In the digital age, digital intervention is the utilization of the features and media symbol system of digital technologies together with various methods and techniques to improve, support, encourage, and facilitate the desired outcomes of target groups via desktop, laptop, mobile, tablet, and wearable devices (Haleem, Javaid, Qadri, & Suman, 2022; PJ, 2021; Yen, 2021; World Health Organization, 2019; Mills, 2011). Digital intervention in educational settings focuses on improving and facilitating learning access, learning processes, and learning outcomes. It may be learning activities, processes, resources, and various environments driven by digital in educational institutions at various levels, including basic education, vocational education, higher education, informal education, and alternative education (Kuosmanen, Fleming, Newell, & Barry, 2017; Haleem, Javaid, Qadri, & Suman, 2022; Sormunen et al., 2020; Yang, Zargar, Adams, Day, & Connor, 2021; O'Connell & Lucić, 2021; Akour & Alenezi, 2022). Examples of digital interventions in educational settings include the use of Internet-based learning, hybrid learning, MOOC platforms, mobile learning apps, student relationship management systems, and virtual classrooms (Rattanasak, 2023; Napaporn et al., 2023; Nittayathamkul et al., 2023; Kohpeisansukwattana, Siriwattananon, & Charoenwanit, 2024; Kaewrattanapat et al., 2023; Raes et al., 2020). However, before a digital intervention can be developed, a thorough context study, feasibility study, and analysis of the factors influencing the desired state should be undertaken to design and develop the appropriate digital intervention (McKenney & Reeves, 2021).

While numerous studies have explored various factors influencing undergraduate students' academic performance across a wide range of disciplines, these investigations often focus on general student populations or disciplines with high popularity, such as health sciences, engineering, or business. However, there is a clear gap in the research regarding the study of factors that may affect the academic performance of pre-service technical teachers, who are undergraduate students preparing to become technical and vocational teachers in the future. This research aims to identify factors predicting pre-service technical teachers' academic performance in an industrial or technical teacher training context.

This research will help those involved in the educational process in industrial or technical teacher training to understand the specific knowledge related to this group of students. We anticipate that the results of this study will result in the creation and advancement of digital tools to enhance the academic performance of technical teachers in the future. In addition, the results could have a significant impact on enhancing the quality of technical teacher training programs at RMUTK's Faculty of Technical Education and similar universities. This will prepare them to be more effective in meeting future challenges in the classroom and workplace.

## **2. Research Objectives**

To examine the correlation between individual-level factors, interpersonal-level factors, institutional-level factors, and the academic performance of pre-service technical teachers.

To investigate significant factors identified as predictors of the academic performance of pre-service technical teachers.

## **3. Conceptual Framework**

The researchers have reviewed, evaluated, and combined previous research from academic research databases, including Scopus, the Education Resources Information Center (ERIC), and Thai Journals Online (ThaiJo). We conducted a scoping review aimed at developing a conceptual framework for investigating the factors influencing the academic performance of undergraduate students in the Faculty of Technical Education, RMUTK.

Our "Triple I Framework" is a conceptual framework that explores individual, interpersonal, and institutional factors influencing the academic performance of undergraduate students at RMUTK's Faculty of Technical Education. This framework works under the premise that a combination of factors classified into three levels—individual, interpersonal, and institutional—may influence the academic performance of future technical educators, particularly in industrial or technical education.

### *3.1 Individual-Level Factors*

At the foundation of the Triple I Framework are the individual-level factors, which are intrinsic to the students themselves.

#### *3.1.1 Gender*

According to research by Montolio and Taberner (2021), gender differences play an important role in influencing the academic performance of undergraduate students. Research indicates that there are marked differences in academic performance between male and female students, especially under conditions of increased stress and pressure. This difference in performance is characterized by male students having superior performance compared to female students in high-pressure situations. These findings underscore the impact of gender differences on academic performance. Furthermore, the research results of Alalouch (2021), which studied cognitive styles, gender, and student academic performance in engineering education—a similar context to industrial or technical teacher training institutions—found that gender was shown to be the best predictor of academic performance, and male students were more capable of adapting to different learning tasks. Similarly, Nagahi et al. (2020) reflected that gender affects the academic performance of engineering students.

#### *3.1.2 Motivation and Attitude towards Learning*

According to Wurf and Croft-Piggin (2015), the investigation into predicting pre-service teachers' academic performance found that undergraduate students' self-reported behavioral engagement and motivation changed. It is the single most powerful predictor of academic performance. This research highlights the important role that motivation and engagement play in an individual's academic performance from the beginning of teacher education. His findings suggest that levels of motivation and engagement serve as a gauge for this. It is closely linked to the academic performance of pre-service teachers. This indicates that these psychological characteristics may have a significant impact on one's ability to succeed academically. Supporting this, studies by Van der Zanden et al. (2018), Arnold and Rowaan (2014), and De Wit et al. (2012) recognize motivation and learning attitudes as critical factors.

#### *3.1.3 Study Habits*

Study habits, as explored by Jafari, Aghaei, and Khatony (2019), found that 81.3% of students displayed average study habits at a moderate level, which was linked to their academic performance. A significant connection was found between study habits and academic performance, highlighting the important impact study habits have on academic success. Based on these results, it is suggested that universities evaluate students' studying behaviors upon admission. Such assessments would enable the identification of areas where students may benefit from targeted training aimed at enhancing their study habits. This notion is corroborated by Magulod Jr. (2019) and Alva and Manuel (2017), who provide empirical evidence that students' study habits significantly influence their academic performance. These studies collectively highlight the critical importance of cultivating effective study habits among students to foster academic success. Therefore, educational institutions are encouraged to implement programs and interventions designed to improve study habits, thereby enhancing the academic performance of their students.

### *3.2 Interpersonal-Level Factors*

The second tier of the framework, interpersonal factors, delves into the social and relational aspects that influence academic performance.

#### *3.2.1 Family Support*

According to the findings of Cheng, Ickes, and Verhofstadt (2012), who conducted a longitudinal study on how family support is related to students' GPA scores, the findings underscore the significant impact of perceived family support on the academic performance of college students. Notably, family support was found to be a significant factor in predicting students' GPA scores over three consecutive semesters, both in terms of their level and consistency. Mishra (2020) supported Cheng et al.'s findings by also stressing the significance of family support in academic performance. Mishra's study explored different aspects of family support, highlighting its crucial role in influencing students' academic performance. The agreement across both studies highlights a

widespread consensus in academia about the strong connection between family support and academic performance. These studies confirm that family support, which includes emotional encouragement and motivational backing, is crucial for improving students' academic performance. This collection of evidence underscores the diverse aspects of family support and how crucial it is to students' academic paths, indicating that implementing strategies to enhance family support could enhance academic performance.

### 3.2.2 Peer Relationships

Yi-Hwa Liou and colleagues (2017) conducted a preliminary investigation on the social aspects of pre-service teacher development, focusing on how social relationships, peer trust, and self-efficacy relate to academic performance. A study carried out in a teacher training program at a university in the United States shows that the performance of pre-service teachers is significantly and positively linked to peer relationships established through strong social connections and trust among peers. Furthermore, Lillo (2018) conducted a qualitative study at the University of California, Los Angeles' IMPACT Urban Teacher Residency Program, emphasizing the significant impact of peers on the educational development of aspiring teachers. Lillo believes that working together, both inside and outside the classroom, is essential for helping pre-service teachers learn and teach. The research also mentions that the program's focus on working together and the use of a cohort model play a major role in strengthening the importance of peer interactions in teacher training.

### 3.3 Institutional-Level Factors

The third and final level of the Triple I Framework focuses on institutional factors, which encompass the broader educational and environmental contexts.

#### 3.3.1 Curriculum Quality

Alexander (2000) conducted research that centers on using econometric methods to examine how curriculum standards impact student achievement. Econometric analysis uses statistical and mathematical models to examine economic data, specifically to explore how establishing curriculum standards impacts students' academic performance. The results of the research suggest that the implementation of curriculum standards, which serve as set educational targets that schools strive to meet, can enhance students' academic performance. This implies that if educational institutions follow a specific set of standards for student learning, it can result in improved academic performance, such as higher grades, improved comprehension, and general success in academics.

#### 3.3.2 Teaching Quality

The study conducted by Atlay, Tieben, Hillmert, and Fauth (2019) explores the relationship between teaching quality and academic performance among students from low and high socioeconomic backgrounds, particularly focusing on how this relationship varies. The findings of their research indicate that effective classroom management plays a significant role in enhancing academic performance. This suggests that good teaching quality benefits all students. However, the study also reveals that students from high socioeconomic backgrounds benefit more substantially from teaching strategies that involve cognitive activation and the creation of a supportive classroom climate.

#### 3.3.3 Learning Environment

Gao (2021) conducted research on the analysis of the network classroom environment on the learning ability of college students. To study the influence of the network classroom environment on the learning ability of university students, one hundred and fifty students from the same major were taken as the experimental subjects, and they learned in the traditional classroom environment and the rain classroom-based network classroom environment, respectively. Then the academic performance and questionnaire survey of the two classes were analyzed. The results showed that the average score of the final exam was 77.2 points and 83.2 points, respectively, in the traditional classroom environment and the online classroom environment. In the network classroom environment, the students had higher performance, the number of students who gained high scores was larger, and their abilities in information processing, autonomous learning, and collaborative learning improved. The experimental results demonstrate that the network classroom environment has a favorable impact on learning ability, thereby contributing to the advancement of network classrooms in higher education institutions. This advancement is advantageous in diversifying students' learning methods and offers novel approaches to enhancing university students' academic performance.

## 4. Research Methodology

### 4.1 Research Design

This study adopts a predictive correlational research design to examine the correlation between individual, interpersonal, and institutional factors, and their predictive power on the academic performance of pre-service technical teachers. This design allows for the identification of significant predictors of their correlation with pre-service technical teachers' academic performance.

### 4.2 Research Setting

The research is conducted within the Faculty of Technical Education at RMUTK, Bangkok, Thailand. This setting provides a unique opportunity to examine factors predicting pre-service technical teachers' academic performance in a technical teacher training context.

### 4.3 Participants

The study was conducted with the underlying population, comprising 148 undergraduate students from the Faculty of Technical Education at RMUTK, during the second semester of the 2021 academic year. The sample size was determined with G\*Power, a statistical power analysis software, in order to have enough power to detect the anticipated effect sizes in the predictive correlational study. We aimed for a moderate correlation effect size ( $r = .3$ ), an alpha level ( $\alpha$ ) of .05 to limit Type I error, and a statistical power ( $1-\beta$ ) of 80% to reduce Type II error risk. Although power analysis recommended a sample size of 31 to detect these effects, we chose 109 students to bolster statistical reliability, manage potential non-responses, and better represent the diverse student population. Stratified random sampling was used to choose a sample of 109 students that accurately represents the division's diverse student population. This method helped ensure an equal distribution of participants from various divisions, with the goal of improving the credibility and applicability of the research findings.

### 4.4 Instruments

The research instrument was an online self-administered questionnaire, divided into two parts: the first part included general information about the students (e.g., gender, year of study, major, cumulative GPA), and the second part focused on factors influencing pre-service technical teachers' academic performance. We developed this questionnaire based on the Triple I Framework. It comprised sections designed to measure individual factors (e.g., gender, motivation and attitude towards learning and study habits), interpersonal factors (e.g., family support and peer relationships), and institutional factors (e.g., curriculum quality, teaching quality, and learning environment). In this context, gender is a dummy variable that is considered one of the individual factors. We measured other independent variables (motivation and attitude towards learning and study habits) using a 5-point Likert scale. We conducted this questionnaire to ensure the validity and reliability of the instrument. The CVI was used to assess the content validity of the questionnaire, with  $S-CVI/Ave \geq 0.90$  indicating an acceptable level of validity. We used the Cronbach's alpha coefficient to assess reliability, which revealed satisfactory consistency among the questionnaire items (Cronbach Alpha = 0.78).

### 4.5 Data Collection Procedures

Data were collected through online surveys, which were distributed to participants via email and university platforms. An online self-administered questionnaire was distributed to 109 undergraduate students in the Faculty of Technical Education at Rajamangala University of Technology Krungthep (RMUTK) between August 1 and August 30, 2022. Notifications were sent to maximize response rates, and the data collection process adhered to a predefined timeline to ensure timely analysis.

### 4.6 Data Analysis

The Pearson correlation coefficient and multiple regression were used in the statistical analysis. The analysis was conducted using statistical software. Results were interpreted in the context of existing literature to draw meaningful conclusions and recommendations for enhancing pre-service technical teachers' academic performance in technical teacher training contexts.

### 4.7 Ethical Aspects

The Thailand Science, Research, and Innovation (TSRI) office's letter with the number MHESI 6309.FB 6.1/1/2564, dated March 18, 2021, served as the foundation for this study's ethical guidelines. According to these guidelines for conducting research in human behavior, social sciences, and the humanities, it was determined that research projects related to instructional processes, or the evaluation of learning and teaching do not require approval from the Institutional Human Research Ethics Committee.

## 5. Results

### 5.1 The Results of the Correlation between Individual-level Factors, Interpersonal-level Factors, Institutional-level Factors, and the Academic Performance of Pre-service Technical Teachers

Table 1. The correlation between individual-level factors, interpersonal-level factors, institutional-level factors, and the academic performance of pre-service technical teachers

<b>Independent Variables</b>	<b>Dependent Variable (Academic Performance)</b>
<b><i>Individual-Level Factors</i></b>	
Gender	.245*
Motivation and Attitude towards Learning	.270*
Study Habits	.272*
<b><i>Interpersonal-Level Factors</i></b>	
Family Support	.263*
Peer Relationships	.184
<b><i>Institutional-Level Factors</i></b>	
Curriculum Quality	.292*
Teaching Quality	.230*
Learning Environment	.047

\* $p < .05$

*Note.* This table presents the Pearson's product moment correlation coefficient, which measure the strength and direction of the linear relationship between each independent variable and the dependent variable (academic performance).

Table 1 presents the correlation between individual-level factors, interpersonal-level factors, institutional-level factors, and the academic performance of pre-service technical teachers. There were three-level factors, as follows:

- 1) Individual-Level Factors: Gender is associated with academic performance, showing a significant positive correlation  $r(107) = .245$ ,  $p < .05$ ). This suggests that, within this group, gender may influence academic outcomes to some extent. The correlation between motivation and attitude towards learning and academic performance is noteworthy, with  $r(107) = .270$ ,  $p < .05$ , indicates a link between increased motivation and a more optimistic outlook on learning with better academic performance. The positive relationship between study habits and academic performance, as shown by  $r(107) = .272$ ,  $p < .05$ , underscores the significance of emphasizing effective study strategies.
- 2) Interpersonal-Level Factors: Family support displays a positive and significant correlation with academic performance  $r(107) = .263$ ,  $p < .05$ ), indicating that support from family can moderately influence the academic performance of pre-service technical teachers. On the other hand, peer relationships showed no considerable link to academic performance,  $r(107) = .184$ ,  $p > .05$ , indicating that they may not have a considerable impact on academic performance in this study.
- 3) Institutional-Level Factors: Curriculum quality showed the most significant positive relationship with academic performance, indicating the crucial importance of curriculum design and content in promoting academic performance, with a correlation coefficient of  $.292$ ,  $p < .05$ . Similarly, teaching quality also showed a strong positive relationship with academic performance, as indicated by a significant correlation of  $r(107) = .230$ ,  $p < .05$ . This signifying the substantial role teachers play in facilitating student learning. Interestingly, the learning environment did not show a statistically significant correlation with academic performance,  $r(107) = .047$ ,  $p > .05$ , indicating that the particular characteristics of the learning environment evaluated may not be the major factor in this context.

### 5.2 The Results of the Investigation Identified Significant Factors as Predictors of the Academic Performance of Pre-service Technical Teachers

Predictive Variables	Unstandardized Regression Coefficient (B)	Standard Error (SE)	Standardized Coefficients (Beta; $\beta$ )	t-test (t)
Gender (X <sub>1</sub> )	.275	.095	.258	2.897*
Motivation and Attitude towards Learning (X <sub>2</sub> )	-.008	.112	-.012	-.073
Study Habits (X <sub>3</sub> )	.143	.079	.233	1.806
Family Support (X <sub>4</sub> )	.021	.095	.034	.225
Curriculum Quality (X <sub>5</sub> )	.090	.137	.133	.657
Teaching Quality (X <sub>6</sub> )	.043	.102	.072	.420

R<sup>2</sup>=.225, SEE=.47707, F=4.928\*, \*p<.05

Table 2 presents the results of the identified significant factors as predictors of the academic performance of pre-service technical teachers. This model investigated the influence of selected independent variables, presumably reflecting different aspects of individual-level factors, interpersonal-level factors, and institutional-level factors on the dependent variable of academic performance. Six predictive variables were included in the model: Gender (X<sub>1</sub>), Motivation and Attitude towards Learning (X<sub>2</sub>), Study Habits (X<sub>3</sub>), Family Support (X<sub>4</sub>), Curriculum Quality (X<sub>5</sub>), and Teaching Quality (X<sub>6</sub>).

Gender (X<sub>1</sub>) emerged as a significant predictor, with an unstandardized regression coefficient (B) of .275 and a standardized coefficient (Beta;  $\beta$ ) of .258. The t-test value for gender was 2.897, surpassing the threshold for significance ( $p < .05$ ), suggesting a strong predictive relationship with academic performance.

The overall model explained approximately 22.5% of the variance in academic performance (R-squared = .225), a significant proportion given the complexity of academic performance ( $F = 4.928$ ,  $p < .05$ ). The standard error of estimate (SEE) was 47707, which provides context for the variability of the predictions. The predictive equation in the form of raw scores can be written as follows:

$$Y' = .258X_1 - .012X_2 + .233X_3 + .034X_4 + .133X_5 + .072X_6$$

## 6. Discussion

The findings from this research provide meaningful insights into the factors influencing academic performance among pre-service technical teachers in industrial or technical teacher training contexts at the Faculty of Technical Education, Rajamangala University of Technology Krungthep (RMUTK).

The predictive correlational research design enabled a comprehensive examination of various factors and their relationships with academic performance. The positive correlations between academic performance and factors such as gender, motivation and attitude towards learning, study habits, family support, curriculum quality, and teaching quality underscore the multifaceted nature of academic performance. These align with existing literature (Montolio & Taberner, 2021; Alalouch, 2021; Nagahi et al., 2020; Wurf & Croft-Piggin, 2015; Jafari, Aghaei, & Khatony, 2019; Cheng, Ickes, & Verhofstadt, 2012; Mishra, 2020; Alexander, 2000; Atlay, Tieben, Hillmert, & Fauth, 2019). These correlations, statistically significant within the confines of this study, suggest that both individual, interpersonal, and institutional-level factors play crucial roles in the academic performance of pre-service technical teachers.

The significance of gender as a predictor of academic performance might also reflect historical and cultural influences on the engagement and success of different genders in technical education. For example, males often receive greater encouragement or opportunities to pursue technical and vocational education compared to females, leading to differences in preparedness and, ultimately, academic performance. This finding compels educators and policymakers to consider gender-sensitive approaches that recognize and accommodate the distinct needs, challenges, and strengths of all students, aiming to provide equitable educational experiences that maximize the academic performance of each gender group.

The association between study habits and academic performance in pre-service technical teachers, indicated by a standardized coefficient of .233 and a t-test value of 1.806, underscores the relevance of effective learning strategies to educational outcomes. This positive correlation suggests that those with disciplined study routines tend to achieve higher academically. Effective study habits facilitate a deeper understanding and retention of complex technical material, which is pivotal in technical education contexts. Despite the positive relationship, the t-test value suggests a modest strength of association. This indicates that while study habits contribute to academic success, they are just one of many factors that influence academic performance.

In the investigation of factors influencing the academic performance of pre-service technical teachers, motivation and attitude towards learning emerged as surprising predictors. Notably, the standardized coefficient for these variables stood at  $-.012$ , suggesting a minimal and inverse relationship with academic performance. This outcome might initially appear counterintuitive, as one would expect positive motivational factors and learning attitudes to enhance academic performance. However, the magnitude of the coefficient indicates that, although statistically significant, the practical impact of motivation and attitude towards learning on academic performance is negligible. Furthermore, the negative direction of the relationship, albeit slight, prompts more reconsideration of the role these factors play in academic performance. It may reflect a scenario where students with lower motivation or less positive attitudes towards learning are compensating through other means, such as increased effort or the use of effective study strategies, leading to a nuanced understanding of academic performance determinants.

Finally, the absence of a significant correlation between peer relationships and academic performance is a particularly intriguing finding, diverging from the common perception that peer interactions are a critical component of the educational experience. This deviation suggests a unique context at RMUTK, where academic performance is more closely tied to personal motivation and the quality of educational delivery than to peer or environmental influences. Similarly, the non-significant correlation between the learning environment and academic performance challenges the conventional wisdom that physical and psychological aspects of the learning space are pivotal to educational success. This suggests that, at least for the population studied, the impact of the learning environment may be less pronounced than traditionally believed.

## 7. Future Research Directions

In this study, an  $R^2$  value of  $.225$  means that approximately 22.5% of the variation in academic performance among the pre-service technical teachers can be explained by the factors we've studied. However, this also implies that around 77.5% of the variance is not explained by our model. This unexplained variance suggests that there are other influential factors influencing academic performance that we haven't included or possibly even identified in our study. Acknowledging this unexplained variance is not a drawback but rather a call to action for research communities, which acknowledging the  $R^2$  value of  $.225$  as a starting point, we propose several avenues for future research to deepen and broaden this understanding, as follows:

### 7.1 Exploration of Additional Variables

Future research should consider incorporating a broader array of predictors, including psychological attributes (e.g., grit, growth mindset, self-concept, self-esteem, self-confidence), digital literacy, and informal learning experiences. This expansion could unveil a more comprehensive understanding of the academic performance determinants of pre-service technical teachers.

### 7.2 Longitudinal and Cross-Sectional Studies

Implementing longitudinal studies can shed light on the evolution of academic performance over time, capturing its dynamics. Concurrently, cross-sectional research across various institutions, cultures, or educational systems might clarify the contextual factors influencing pre-service technical teachers' academic performance.

### 7.3 Methodological Diversification

Utilizing diverse methodological approaches, including structural equation modeling and mixed methods research, can reveal the complex interplay between variables affecting pre-service technical teachers' academic performance. Such diversification addresses the limitations inherent in linear predictive models.

### 7.4 Digital Intervention Studies

By designing and evaluating digital interventions aimed at the significant predictors identified, researchers can test the causal relationships and develop practical strategies to improve academic performance. As technology becomes more important in education, it is therefore important to explore the impact of the digital divide on academic performance. Future research should examine how the availability and use of digital tools affect pre-service technical teachers' academic performance.

## 8. Conclusions

This investigation into the academic performance of pre-service technical teachers has identified crucial individual, interpersonal, and institutional-level factors. Despite a modest  $R^2$  value of  $.225$ , the study underscores the multifaceted nature of academic performance and the significant impact of both individual-level factors, interpersonal-level factors, and institutional-level factors.

Gender differences indicate societal and cultural impacts on educational opportunities, while the unexpected



minimal effect of motivation and attitude suggests complexities beyond traditional assumptions. Study habits show a positive but modest relationship with academic performance, emphasizing the importance of effective learning strategies.

The findings not only enhance our understanding of academic performance determinants in technical education but also highlight the potential of digital interventions in addressing the needs of future educators. As the landscape of education continues to evolve, our study serves as a vital resource for RMUTK and similar institutions aiming to refine their teacher education programs. By exploring additional factors and employing diverse methodological approaches, future research can build on our work, further supporting the development of capable technical teachers ready to face the challenges of the digital era and the professional world.

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### **Authors contributions**

Dr.Sukit Chiranorawanit was responsible for study design, data collection, and data analysis. Dr.Vitsanu Nittayathamkul was responsible for revising. All authors read and approved the final manuscript.

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### **Informed consent**

Obtained.

### **Ethics approval**

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### **Data availability statement**

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

### **Data sharing statement**

No additional data are available.

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