THE INFLUENCE OF SELF-REGULATED LEARNING, SELF-EFFICACY, AND GRIT ON LEARNING PERFORMANCE AT HONGHE VOCATIONAL AND TECHNICAL COLLEGE, YUNNAN PROVINCE

MAN LI

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
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RAJAMANGALA UNIVERSITY OF TECHNOLOGY KRUNGTHEP
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APPROVAL PAGE

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Author   Man LI
Major   Master of Management (Management Science)
Advisor   Dr. Surachai Traiwannakij

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ABSTRACT

In 1972, UNESCO's report "Learning to Be: The World of Education Today and Tomorrow" emphasized the importance of students becoming the focus of school education, capable of self-directed learning to adapt to a rapidly changing world. By the 1980s, learning performance gained attention in educational psychology and American education, highlighting learners' strategic and goal-oriented approaches. China's curriculum reform reflects this trend, with the 2014 "Curriculum Standards for Twelve-Year Basic Education," implemented in 2019, emphasizing student-centered personalized education to promote innovation and lifelong learning. This study employs a questionnaire survey to investigate the impact of Self-regulated Learning, Self-efficacy, and grit on Learning Performance. Through various statistical analyses, this study concludes that differences in Gender, Age, Major, and Grade Level generate differences in Students' Learning Performance. Specifically, female students exhibit significantly higher Learning Performance compared to male students. Students majoring in Preschool Education have the lowest learning performance, and those in Firefighting have the highest. Learning Performance increases significantly with age, with 17-year-old students showing higher effectiveness than 15-year-olds and 16-year-olds. First-year university students have significantly lower Learning Performance than second-year and third-year students. The multiple linear regression analysis indicates that these three factors — namely, Self-regulated Learning, Self-efficacy, and grit — significantly impact Learning Performance.

Keywords: Self-regulated Learning, Self-Efficacy, GRIT, Learning Performance

ACKNOWLEDGEMENTS

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

1.1 Background and Statement of the Problem

The United Nations Educational, Scientific and Cultural Organization (UNESCO) published the report "Learning to be: The world of education today and tomorrow" in 1972, which emphasized that students should be at the center of school education. Students need to possess the ability to educate themselves and engage in self-learning in order to adapt to the rapidly changing world. Therefore, how to educate students to become autonomous learners and how to cultivate students' ability to learn independently have become new topics for teachers in the 21st century. In the 1980s, the concept of self-regulated learning, also known as learning performance, began to receive attention and discussion in the fields of educational psychology and the American education sector. It mainly emphasizes that learners are strategic and goal-oriented during the learning process. They can adjust their Energetic Reaction, apply learning strategies, and control their learning behavior to achieve learning goals, which resonates with UNESCO's proposed 21st-century competencies.

The recent emphasis on enhancing students' learning performance internationally is also reflected in China's latest curriculum reform. In 2014, the Ministry of Education announced the "General Outline of the National Basic Education Curriculum for Twelve Years," which officially took effect in 2019 (Republic of China year 108). This curriculum is commonly referred to as the "108 Curriculum" or "New Curriculum." The 108 Curriculum lists "achieving every child-promoting individual talents, lifelong learning" as its reform vision, emphasizing student-centered learning through personalized education to stimulate students' innovation and desire to learn, enabling them to become adaptable and socially resilient lifelong learners. To provide students with opportunities for learning performance within the framework of the new

curriculum, the Ministry of Education has allocated a weekly "flexible learning time" of 0 to 2 periods in each term, totaling 6 to 12 periods over six terms (adjusted to a total of 4 to 12 periods after the 111 academic year). This time can be used for students' learning performance and other activities, such as enrichment or remedial teaching, talent training, and school-specific activities. When promoting learning performance, schools are encouraged to establish regulations regarding flexible learning time, including implementation principles, reference formats for students' learning performance plans, and guidance management. Learning performance refers to students planning their learning within the school's implementation standards, including learning themes, methods, progress, content, and required resources, with guidance from teachers and agreement from parents or guardians (Ministry of Education, 2014, 2018).

Enhancing students' Earning Reaction is a significant focus of the new curriculum. When students can learn things they are interested in on their own, their Eager Reaction flourishes. The ultimate goal of learning performance is to empower students to say, "I want to learn this." Therefore, in learning performance, teachers should play a guiding and supportive role, intervening only when necessary (Zhang et al., 2020). Many principals express that one of the purposes of learning performance is to provide students with opportunities to learn from failure experiences. Since plans sometimes fail due to changes, experiences of failure can be valuable as a basis for adjusting plans. Once students acquire this ability, they are more likely to become lifelong learners (Luan et al., 2020).

The concept of self-regulated learning has sparked discussions among many scholars. Karabenick and Zusho (2015) conducted in-depth research on self-regulated learning. He believed that self-regulated learning is based on six different theories. From a social cognitive theory perspective, he argued that an individual's behavior results from the interaction of personal cognition, behavior, and environment. Individuals can adjust their behavior through self-awareness, self-reflection, and self-

regulation. In other words, individuals may experience discrepancies arising from setting goals that are slightly higher than their current capabilities, which can lead to a psychological imbalance. By seeking necessary strategies to achieve goals and resolve discrepancies, individuals can set higher-level goals and adjust strategies during the process of discrepancy generation and resolution, thereby engaging in self-regulation.

Studies indicate that self-regulated learning is an important factor influencing individuals' learning performance outcomes (Berkhout et al., 2015). Moreover, self-efficacy is a key factor in the process of self-regulated learning. Noted that self-regulated learners tend to have higher self-efficacy. Self-efficacy directly or indirectly affects learning performance. Individuals with higher self-efficacy exhibit stronger motivation and high-quality learning strategies, making them more capable of achieving challenging goals (Wanet et al., 2012). Panadero (2017) also considered learning performance as a critical factor in successful learning. Autonomous learners are aware of their abilities and the demands of their tasks, demonstrating higher levels of self-efficacy. Research has shown that learners with higher self-efficacy are better able to manage their study time and are more likely to seek assistance.

Through an in-depth discussion of self-regulated learning and its role in 21st-century education, this study emphasizes the necessity of cultivating students' ability to become autonomous learners. Faced with the challenges brought about by globalization and technological innovation, individuals who are capable of self-directed and lifelong learning are more likely to adapt to future work and social environments. The education system, particularly educational reforms such as China's 108 Curriculum, echoes the vision advocated by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) to learn to live, committed to promoting the individualized development and continuous learning of every student. This study aims to investigate the impact of self-efficacy, perseverance, and personal factors on learning performance outcomes, offering insights for designing more effective teaching strategies and learning environments.

This study contributes to the current research field by examining the theory and practice of self-regulated learning, thus assisting educators in better understanding and applying these principles. By promoting self-regulated learning, students can achieve academic success and develop into lifelong learners with essential skills for the future. The focus of this study is to develop methods and strategies to promote students' learning performance and explore how this can be achieved through support and improvements in the education system. The findings aim to provide a solid foundation for achieving broader educational goals—cultivating citizens capable of active learning, adapting to change, and contributing to society.

1.2 Research Questions

The research questions are as follows:

(1) What are the impacts of students' factors on Learning Performance?

(2) What are the impacts of students' self-regulated learning on Learning Performance?

(3) What are the impacts of students' self-efficacy on Learning Performance?

(4) What are the impacts of students' perseverance on Learning Performance?

1.3 Research Objectives

This study aims to investigate the relationships between self-efficacy, perseverance, self-regulated learning, and learning performance among students in technical high schools. Based on the research background and motivation outlined above, the objectives of this study are as follows:

(1) To understand the current status of self-regulated learning, self-efficacy, perseverance, and learning performance of students in technical high schools.

(2) To investigate the interrelationships among self-efficacy, perseverance,

self-regulated learning, and learning performance of students in technical high schools.

1.4 Research Framework

This conceptual framework has evolved from research on the impact of students' Self-regulated Learning, Self-efficacy, and Perseverance (GRIT) on learning performance Outcomes (Schunk & Usher, 2011).

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┌─────────────────────────────────┐
│ Demographic Factor              │
└─────────────────────────────────┘

┌─────────────────────────────────┐                    ┌──────────────────────────┐
│ Self-regulated Learning         │        H1          │ Learning Performance     │
│ - Cognitive Strategies          │                    │                          │
│ - Metacognitive Strategies      │                    │ -Earner Reaction         │
│ - Prior Knowledge               │        H2          │                          │
├─────────────────────────────────┤                    │ -Knowledge Tests         │
│ Self-Efficacy                   │                    │ -Skill Demonstrations    │
│ - Internally Directed Self-Efficacy │    H3          └──────────────────────────┘
│ - Empathetic Self-Recovery Ability │
└─────────────────────────────────┘

┌─────────────────────────────────┐
│ Grit (Perseverance)             │        H4
│ - Interest                      │
│ - Practice                      │
│ - Purpose                       │
│ - Hope                          │
└─────────────────────────────────┘
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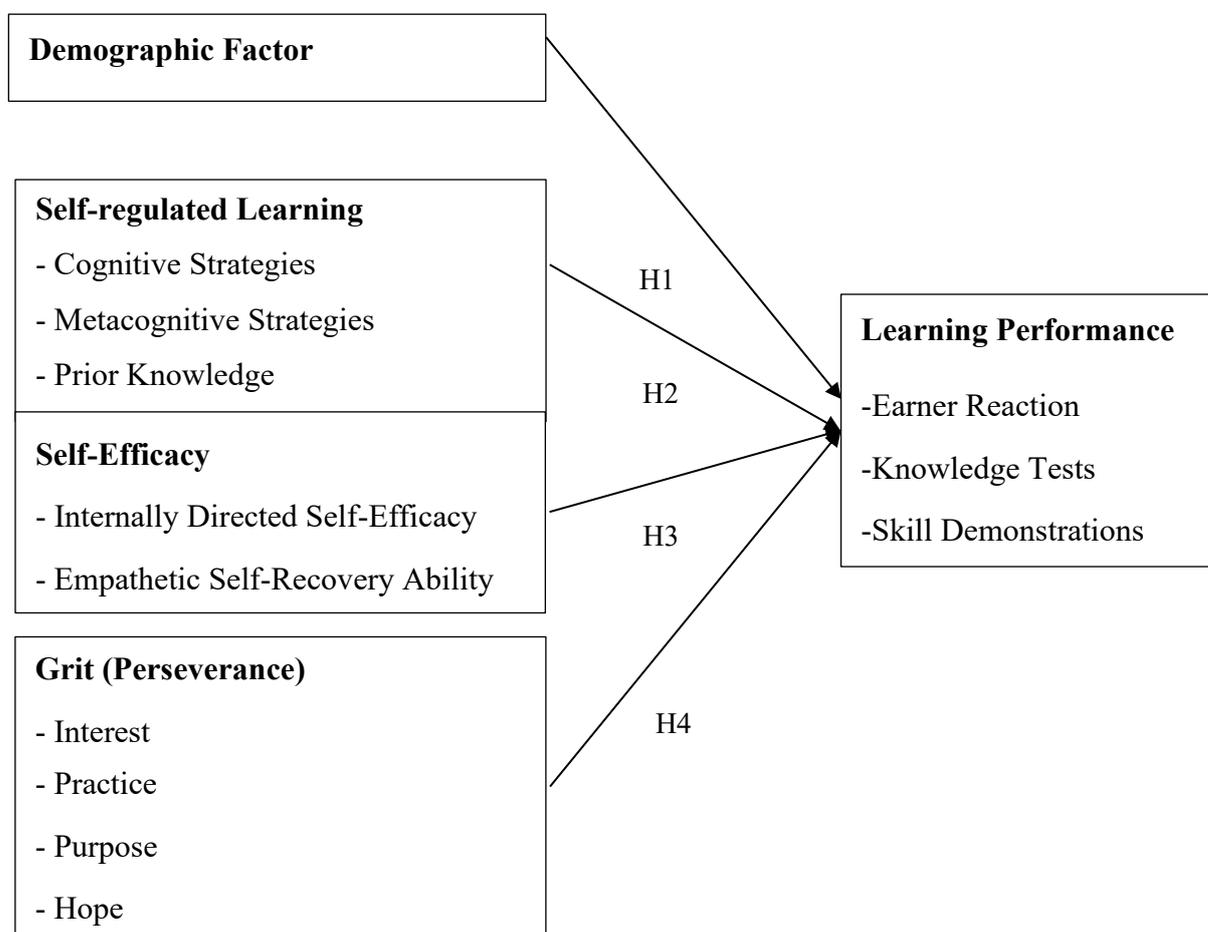
Figure 1.1 Conceptual Framework

1.5 Research Hypotheses

Based on the research questions above, the following research hypotheses can be proposed:

H1: Differences in Demographic Factors generate differences in Learning Performance

H2: Self-regulated Learning Influences on Learning Performance

H3: Self-efficacy Influences on Learning Performance

H4: Grit Influences on Learning Performance

1.6 Scope of the Research Study

1.6.1 Content

This study focuses on investigating the impact of students' self-regulated learning, Self-Efficacy, and Grit on Learning Performance among students of Honghe Vocational and Technical College in Yunnan. The independent variables are students' Self-regulated Learning, Self-efficacy Learning, and Grit, while the dependent variable is Learning Performance.

1.6.2 Area of Study

This study focuses on students at Honghe Vocational and Technical College in Yunnan Province.

1.6.3 Population and Samples

The target population of this study consists of 6,770 secondary vocational students from Yunnan Honghe Vocational and Technical College, with participants required to have engaged in at least one semester of learning performance during flexible study time. A list of students whom scholars and experts have recommended as capable of embodying the spirit of learning performance in the new curriculum will be obtained. All schools are requested to assist in inviting students who have engaged in learning performance for at least one semester and are willing to participate in the study.

Among these 6,770 students, there are 2,250 first-year students, 2,300 second-year students, and 2,220 third-year students. These students from each grade have participated in learning performance to a certain extent and meet the basic requirements for participation in the study. This distribution ensures the diversity and representativeness of the sample, thereby enhancing the credibility and universality of the study results.

The sample collection for this study was conducted acrossthe above-mentioned 3 educational levels,: first-year students, second-year students, and third-year students, totaling approximately ccording to Yamane (1967), under a 95% confidence level, if the population size is 6,000 units, the sample size is 375 units; if the population size is 7,000 units, the sample size is 378 units. Since the population in this study is 6,770 units, the sample size is then equal to 378 units. However, to make it more convenient and precise, the total number of samples in this study is 400. The proportion criterion is applied in this study, that is, 133 samples from first-year students, 136 samples from second-year students, and 131 samples from third-year students.

1.6.4 Sampling Method

The Probability Sampling Method, also known as elementary random sampling, is employed in this study.

1.6.5 Duration of Study

This study was conducted from July to November 2024.

1.7 Definition of Key Terms

Self-Regulated Learning: Self-regulated learning involves learners setting appropriate goals based on self-assessment of their abilities and the environment, utilizing suitable learning strategies, monitoring progress, and making corrections as necessary to achieve their learning goals.

Self-Efficacy: Self-efficacy refers to an individual's belief in their ability

to accomplish tasks. The level of self-efficacy influences differences in student behavior when performing tasks.

Grit: Grit refers to an individual's persistent passion and perseverance towards long-term goals, even in the face of challenges or failures, and continuing efforts until the goals are achieved.

Learning Performance： Learning performance in this study refers to the learning activities that students engage in during flexible learning time independently. Learning outcomes refer to the fundamental changes in cognition, skills, and affect that learners experience after engaging in learning activities.

1.8 Research Significance

The significance of this study lies in its exploration of the relationships among self-efficacy, perseverance, self-regulated learning, and learning performance outcomes among students in technical high schools. By examining these factors, this study contributes to the understanding of how students in technical high schools perceive their abilities, exhibit perseverance, engage in self-regulated learning practices, and achieve learning performance outcomes.

Understanding the current status of these factors and their interrelationships can provide valuable insights for educators and policymakers in designing effective interventions and support systems to enhance students' learning performance in technical high schools. Moreover, validating the model influencing learning performance outcomes can contribute to the development of comprehensive frameworks for promoting learning performance and fostering student success in technical high school settings. Ultimately, the findings of this study have the potential to inform educational practices and strategies that can optimize students' learning experiences and outcomes in technical high schools.

CHAPTER II

LITERATURE REVIEW

2.1 Related Theories

2.1.1 Theory of Self-regulated Learning

The term "Self-Regulated Learning (SRL)" has been translated differently by Chinese researchers, including "Self-disciplined Learning," "learning performance," "Self-regulated Learning," and "Self-controlled Learning." It mainly discusses the active learning patterns of learners in terms of cognition, metacognition, behavior, and motivation. This concept originates from Bandura's Social Learning Theory, which posits that in a learner-centered learning process, individuals, under the interactive influence of cognition, environment, and behavior, use strategies to adjust their behavior, change self-efficacy, and achieve learning goals (Panadero, 2017). Wolters and Brady (2021) believe that self-regulated learning encompasses any cognitive process related to learning that can maintain and promote learning behaviors, ultimately achieving learning goals.

Butler (2022) has compiled numerous theories related to Self-regulated Learning, including the Social Cognitive Theory, the Volition Theory, the Humanistic theory, and the hierarchy of needs. Studies also suggest significant differences in self-directed learning among students of different grade levels (Patrick & Middleton, 2002). Furthermore, Perry et al. (2002) focused on Taiwanese university students and noted that higher-grade students exhibit better self-regulated learning abilities than their lower-grade counterparts; these self-regulated learning abilities have a positive impact on learning outcomes.

2.1.1.1 Social Cognitive Theory

Schunk and DiBenedetto (2020) proposed the theory of reciprocal

determinism, emphasizing the interactive process among individuals, behavior, and environment as the journey of self-regulated learning. Key factors influencing this interaction include self-efficacy. In this model, at the "individual" level, factors influencing learners include self-efficacy, prior knowledge, and metacognition. Learners' motivation primarily stems from their interpretations and judgments of past behavioral outcomes. Self-efficacy helps learners set goals; individuals with higher self-efficacy tend to set more ambitious goals or employ more effective strategies, resulting in greater motivation and interest. Factors at the "behavior" level include self-observation, self-judgment, and self-reaction. Learners monitor their behavior, compare it to established standards, and generate positive or negative emotions based on their self-evaluation. Environmental factors include setting experiences, observing others' behaviors and outcomes, assistance from important others, and the learning environment. Learners may recall past successful experiences and receive encouragement from individuals with similar abilities or significant others, which leads to higher self-efficacy and enhances an individual's confidence in completing tasks.

In conclusion, the social cognitive perspective suggests that learners are influenced by individual, behavioral, and environmental factors during the learning cycle. They adjust their learning strategies through metacognition and self-assessment, developing the ability to self-monitor and self-correct. Self-efficacy can influence learners' goal setting, commitment, and, consequently, their learning effectiveness. Education should focus on guiding learners to develop higher self-efficacy by providing a conducive learning environment that fosters positive learning behaviors and performance through scaffolding and observation.

2.1.1.2 Volition Theory

Haggard (2019) suggests that while learners are initially motivated to learn new things, their decisions and outcomes are ultimately influenced by volition after the learning process has begun. Learners should adjust their motivation, cognition, and emotions promptly and maintain their action intentions until their goals are achieved.

To help learners overcome internal and external distractions and enhance their focus in learning, he presents six action control strategies: the selective attention strategy, the encoding control strategy, the emotion control strategy, the motivation control strategy, the environmental control strategy, and the information processing simplification strategy.

Mudrik et al. (2020) expand Kuhl's theory to learning contexts, interpreting these action control strategies as volitional control strategies, categorized into implicit control and explicit control. Advocates of volition theory suggest that action volition acts as an intermediary variable between goals and outcomes. Learners who effectively utilize action control tend to achieve better learning outcomes.

2.1.1.3 Humanistic Theory

Javadi and Tahmasbi (2019), the humanistic psychologists, proposed that teachers should prioritize student learning in teaching, emphasizing learners' potential for self-actualization. Individuals should understand their true selves, actively engage in learning and exploration based on their growth needs. Teachers play a crucial role in providing resources and catalyzing learning, enabling students to acquire the knowledge they need autonomously. Rogers believes that mutual relationships are essential for genuine personal growth and thus introduces five important principles of humanistic learning, including the potential for learning, curiosity promoting development and learning, the significance of material depending on learners' perspectives, progress resulting from learners' active participation in learning activities, cultivation of independent thinking and creativity through self-assessment, and the emphasis on life skills learning.

2.1.1.4 Hierarchy of Needs

Gawel (2019), the father of humanistic psychology, introduced the hierarchy of needs, which aligns with these views. Needs are categorized into basic needs (physiological, safety, love and belonging, esteem) and growth needs (cognitive, aesthetic, self-actualization). If basic needs remain unfulfilled, growth needs will not

emerge. Satisfaction of both basic and growth needs enhances motivation, prompting individuals to continually seek further fulfillment. Learning is intrinsic, originating from learners' inner psychological needs. The most significant motivation arises when learning meets individual needs. In essence, humanistic theory emphasizes learners' autonomy in the learning process, where they actively construct knowledge. Learning's significance lies in self-completion, emphasizing the freedom to choose educational activities, self-guidance, self-evaluation, and self-actualization. Self-regulated learning adjustment embodies learners' agency in achieving preset goals, utilizing their learning strategies effectively to adjust cognition, behavior, and motivation.

2.1.2 Theory of Self-Efficacy

Lippke (2020), drawing on the perspectives of behavioral and cognitive psychology, introduced the Social Learning Theory, which emphasizes the human capacity for self-regulation. Building upon this theory, Schunk and DiBenedetto (2022) proposed the Social Cognitive Theory, focusing on individual beliefs and the ability to regulate one's behavior and thoughts, with individual self-adjustment at its core. He highlighted that learning is a continuous process involving interactions between oneself and the social environment. Within the social environment, individual behavior, environmental factors, and self-perception of the environment mutually influence one another. Hence, the three factors of individual, environment, and behavior form the triadic orientation of the Social Cognitive Theory, also known as the Triadic Theory of Learning. In this Social Cognitive Theory, Bandura analyzed the sources and dimensions of self-efficacy. Céspedes et al. (2021) highlight that self-efficacy is a strong predictor of academic success, often surpassing other motivational constructs.

Studies such as those by Zelenak (2019) and Olave (2019) further confirm that self-efficacy has a significant impact on academic performance across various educational levels and contexts. Educators can enhance students' self-efficacy through structured mastery experiences, role modeling, constructive feedback, and effective management of emotional states. By fostering a supportive environment and

celebrating incremental successes, teachers can help students develop the confidence necessary to achieve their academic goals, thereby underscoring the importance of self-efficacy in education.

Cansiz and Cansiz (2019) view self-efficacy as a personal belief that reflects an individual's confidence level in achieving a desired performance level. It reflects one's confidence in effectively reaching expected goals through personal ability. Lopez et al. (2021) consider self-efficacy as an individual's comprehensive evaluation of their abilities in a particular task. Efficacy judgments can change over time due to experiences of success or failure, age, and the acquisition of new knowledge. Particularly, when individuals experience success, efficacy assessment significantly increases, leading to a belief in their ability to accomplish challenging tasks. Domestic scholar Luo et al. (2022) define self-efficacy as an individual's subjective assessment of their ability to handle challenging tasks and evaluate the potential completion level of those tasks. Çınar-Tanrıverdi and Karabacak-Celik (2023) point out that self-efficacy is the belief in one's ability to execute and accomplish set task objectives, affecting an individual's motivation, emotions, and behaviors.

In summary, self-efficacy represents an individual's confidence in their ability to achieve expected goals, reflecting their execution capabilities, and does not necessarily denote actual capability. Self-efficacy varies for individuals across different tasks or situations. In this study, self-efficacy refers to general self-efficacy, which is defined as an individual's belief in their ability to accomplish a task.

2.1.2.1 Sources of Self-Efficacy

(1) Past Performance Accomplishments: Individuals assess their abilities through direct experiences of past successes or failures. Positive experiences lead to increased self-efficacy, whereas repeated failures tend to lower self-efficacy.

(2) Vicarious Experience: Individuals observe or imagine behaviors and outcomes of people similar to themselves. Witnessing similar individuals succeed enhances one's belief in their abilities.

(3) Verbal Persuasion: Through verbal encouragement or suggestions from others, individuals believe in their capabilities to accomplish tasks. Positive feedback or trust expressed by significant others boosts self-efficacy, encouraging sustained effort in task completion.

(4) Emotional Arousal: An individual's physiological state influences their perception of stress and adversity. Different emotional states based on physiological conditions affect self-efficacy. Lower levels of anxiety lead to a belief in control over situations, while high levels of anxiety often result in self-doubt.

In conclusion, various interconnected factors influence self-efficacy, which is a key determinant of behavioral motivation. Interventions targeting these aspects can impact individual motivation. During the learning process, learners can transform these aspects into practical strategies, thereby enhancing their self-efficacy in academic endeavors.

2.1.2.2 Dimensions of Self-Efficacy

(1) Magnitude: Refers to the perceived difficulty level of tasks that individuals believe they can accomplish. Higher self-efficacy leads individuals to tackle more challenging tasks, while lower self-efficacy limits them to simpler tasks.

(2) Strength: Indicates the degree to which persuasive arguments can sway individuals. Those with higher self-efficacy are less intimidated by complex problems, while individuals with lower self-efficacy are easily discouraged.

(3) Generalizability: Reflects the extension of self-efficacy across specific situations, applying efficacy to diverse contexts. Some individuals believe they can accomplish certain tasks in specific scenarios, while others feel confident in achieving particular tasks irrespective of the situation.

2.1.3 Theory of Grit

Grit, a concept popularized by psychologist Angela Duckworth, refers to a combination of passion and perseverance in pursuit of long-term goals. This trait emphasizes sustained effort and interest over extended periods despite obstacles and

setbacks. Tiwari and Verma (2023) defined grit as distinct from, yet related to, other constructs such as self-control and conscientiousness. Individuals with high levels of grit are more likely to maintain their determination and motivation over the years, achieving high levels of success and mastery in any field. Empirical studies, such as those by Wu and Mcllroy (2023), have consistently demonstrated that grit is a significant predictor of achievement, correlating with higher GPAs, retention rates, and graduation rates. A meta-analysis by Akos et al. (2017) further revealed that the perseverance component of grit is a more robust predictor of academic performance than the consistency component. Singh (2021) suggests that high achievers typically focus on specific goals for an extended period, undeterred by external factors, demonstrating a resilient trait. He emphasizes that perseverance is more important than intelligence; effort, along with years of persistence, leads to success. Tiwari and Verma (2023) interviewed professionals in investment banking, painting, journalism, academia, medicine, and law. They discovered that their common traits were not innate talents but rather ambitious attitudes and relentless efforts that contributed to their success.

Duckworth (2016) suggests that grit comprises two dimensions: passion, which indicates sustained dedication and a deepening interest in goals over time, and perseverance, referring to continued effort and resilience in the face of challenges or failures. Grit is considered a key factor in achieving high performance.

Wu and Mcllroy (2023) believe that an individual's grit can be cultivated through personal drivers or environmental factors. The internal drivers for developing grit include interest, practice, purpose, and hope, which collectively aid in cultivating grit.

Interest: Passion stems from genuinely enjoying the tasks one undertakes.

-Practice: Striving to do things better each day than the day before.

-Purpose: Firmly believing that what one is doing is important for passion to mature.

-Hope: A resilience that can face any circumstance.

The external environmental factors that contribute to cultivating grit include family upbringing, extracurricular activities, and cultural organizations (Coates, 2017).

-Family Upbringing: It is a significant force. Duckworth found that, through visiting exemplary individuals with grit, there was someone in their lives at crucial moments who encouraged them in the right way to set ambitious goals, providing the necessary assistance and trust they urgently needed.

-Extracurricular Activities: Practicing perseverance in challenging tasks. Research has shown that students consistently engaged in extracurricular activities tend to possess higher levels of grit. Therefore, diligence and hard work can be acquired through practice. Participating in one or two extracurricular activities is an excellent opportunity to cultivate grit.

-Cultural Organizations: Remarkable motivational influence of surrounding peers. To enhance grit, consider joining cultural organizations or groups that are known for their high levels of grit.

2.1.4 Theory of Learning Performance

The Theory of Learning Performance emphasizes various evaluation methods to measure learning outcomes and learner progress comprehensively. By integrating multiple evaluation methods, educators and trainers can gain a more comprehensive understanding of learners' learning conditions, thereby optimizing teaching strategies and enhancing educational quality. These evaluation methods include the following:

Learner reaction surveys are typically conducted through questionnaires and are sometimes referred to as "smile sheets." These surveys measure learners' immediate reactions and satisfaction with the training or educational course. By collecting subjective feedback from learners, educators can gain insights into their perceptions of the teaching content, instructional methods, and overall learning

experience. One key advantage of this method is the ability to promptly identify issues in the teaching process and make swift adjustments. As described in the Kirkpatrick model, learner satisfaction is the most basic level of evaluation but is also a necessary condition for effective learning (Qureshi et al., 2021).

Knowledge tests evaluate learners' mastery of the material through formal exams or assessments. This method typically includes multiple-choice questions, true/false questions, short-answer questions, and other formats to measure learning outcomes quantitatively. The results of knowledge tests can help educators determine whether learners have achieved the expected learning objectives and identify which knowledge areas require further reinforcement. According to Bloom's Taxonomy of Educational Objectives, knowledge tests can help assess learners' abilities in terms of remembering, understanding, and applying cognitive skills (Talan, 2020).

Learning performance, often referred to as self-directed learning, emphasizes the role of learners in taking control of their educational processes. Rooted in constructivist principles and self-determination theory, learning performance fosters intrinsic motivation, critical thinking, and lifelong Knowledge. Theories by Jean Piaget and Lev Vygotsky highlight the importance of active engagement and social interaction. In contrast, Liu et al.'s self-determination theory (2019) asserts that autonomy is essential for psychological well-being and intrinsic motivation. Empirical studies, such as those by Wei and Chou (2020), demonstrate that learning performance enhances critical thinking, problem-solving skills, and self-regulation, leading to better academic performance. A meta-analysis by López et al. (2021) further supports that self-directed learners achieve superior learning outcomes compared to those in traditional settings.

Educators can foster learning performance by incorporating strategies that promote student choice, self-regulation, and active engagement. Providing students with opportunities to set their own learning goals, design their activities, and reflect on their learning processes can significantly enhance learning effectiveness. Zhang et al. (2020) recommend integrating e-learning tools, such as online forums, digital portfolios,

and interactive simulations, to facilitate self-directed learning. Creating a classroom culture that encourages curiosity, exploration, and collaboration further supports the development of autonomous learners. Overall, learning performance not only improves academic performance but also equips students with essential skills for lifelong learning.

Schmidt and Lee (2019) and other scholars have demonstrated that good self-regulation and learning abilities can significantly improve learning efficiency. Learners can control their learning process more effectively by setting goals, organizing plans, monitoring progress, adjusting strategies, and engaging in self-reflection, thereby enhancing their learning outcomes. Schunk and Zimmerman (2023) note that Self-Determination Theory posits intrinsic motivation as a crucial driving force that encourages individuals to engage in learning and persist in their efforts. Additionally, Ariastuti and Wahyudin's (2022) concept of self-efficacy highlights the importance of an individual's belief in their capabilities during the learning process. These beliefs can motivate learners to face difficulties and challenges and persist with their studies.

Skill demonstrations involve practical tasks and performances, primarily used to assess learners' ability to apply the skills they have learned in real-world contexts. This evaluation method is particularly suitable for vocational training, laboratory courses, and hands-on classes. Through observation and assessment, educators can gain insight into learners' practical abilities and proficiency in specific skills. Skill demonstrations not only reflect learners' actual operational levels but also evaluate their problem-solving skills and ability to handle real-life challenges. For example, in medical education, skill demonstrations may include simulated patient care and emergency procedures to assess the clinical skills of medical students.

By integrating these diverse evaluation methods, the Theory of Learning Performance provides a comprehensive and systematic approach to assessing and enhancing learners' learning outcomes. This approach not only helps to understand the current learning status but also provides data support for future teaching improvements. Through timely feedback and continuous evaluation, educators can continually refine

their teaching strategies to meet learners' needs, thereby achieving an overall improvement in educational quality.

2.2 Related Studies

2.2.1 Self-Regulated Learning

Self-Regulated learning (SRL) is a key concept in educational psychology that emphasizes the importance of students' self-management in the learning process. Based on Bandura's social cognitive theory, SRL involves three main phases: the forethought phase, the performance phase, and the self-reflection phase. In the forethought phase, students conduct task analysis, set specific goals, and formulate strategic plans. During the performance phase, they employ various strategies to stay focused and manage their learning effectively. In the self-reflection phase, students evaluate their performance and outcomes, making adaptive responses. This self-regulatory capability is considered a crucial factor for academic success.

A substantial body of empirical research shows that self-regulated learning has a positive impact on students' academic performance. For instance, studies by Rovers et al (2019) found that students who reported higher levels of self-regulation and intrinsic motivation exhibited better academic performance and cognitive engagement. A meta-analysis by Wolters and Brady (2021) further confirmed that SRL interventions, which include cognitive, metacognitive, and motivational components, significantly improve students' academic outcomes. Therefore, educators can enhance students' self-regulated learning abilities by encouraging goal setting, teaching learning strategies, and providing opportunities for self-reflection, thereby improving their learning performance capabilities and academic achievements.

Many scholars have provided explanations for the implications of self-regulated learning. Meece (1994) defines self-regulated learning as the process by which learners control and direct their actions. Butler (2022) further analyzes the

concept, stating that self-regulated learning is a combination of knowledge, beliefs, and skills, including metacognition, intrinsic motivation, and action strategies. Carter Jr. et al. (2020) suggest that self-regulated learning involves Knowledge Tests and is a process of self-guidance for learners, encompassing cognitive, behavioral, emotional, and situational factors.

In summary, the related behaviors and processes of self-regulated learning include learners' cognition, metacognition, motivation, environmental and resource management, emotions, learning strategies, and scaffolding (Šimić Šašić et al., 2023). In self-regulated learning, learners are in control, choosing suitable learning methods and planning coherent and meaningful learning processes and actions to achieve learning goals.

Based on the literature mentioned above, self-regulated learning encompasses various meanings, stimulating learners' interest, self-belief, and motivation through diverse factors, including individual, environmental, and behavioral aspects, thereby demonstrating more effective learning strategies. The key points include: 1. Learners can actively plan their learning progress, gradually transitioning from short-term to long-term goals; 2. Learners can identify suitable learning strategies for themselves. Learners can self-assess and adjust their learning methods throughout the learning process. When needed, learners will actively seek help, encouraging continuous effort towards their goals through the support or assistance of significant others.

Through the compilation of relevant research literature, it is found that studies primarily focus on subject-area learning. For example, Newman (1994) invited 290 second-year junior high school students from northern Taiwan to participate in a study. The research indicated that around 45% of the total variance in junior high school students' reading comprehension can be explained by self-regulated learning variables. In other words, students with better self-regulated learning tend to perform better academically. Robb (2016) focused on German language learners, comparing the

differences in offline and online self-regulated learning in terms of learning effectiveness. The results showed that individuals with higher self-regulated learning abilities achieved better German language learning scores compared to those with lower self-regulated learning abilities. This highlights the significant role of self-regulated learning ability in enhancing academic performance.

Moreover, studies suggest that motivational orientation within self-regulated learning has the most explanatory power for learning outcomes. For instance, Zhang (2022) conducted a questionnaire survey targeting adult learners of English-related courses offered by foreign language departments in universities in the Greater Taipei area. The research findings revealed a significant positive correlation between adult English learners' self-regulated learning and learning effectiveness. Additionally, Eom (2019) studied university students learning via E-learning methods and found that self-regulated learning influences learning outcomes, with motivation being the strongest predictive factor. Chen (2020) analyzed all junior high school students in the country and found that students' self-regulated learning in civic and social sciences falls within the medium to high range, with the "motivation/emotion" aspect being most crucial. Different background variables exhibit significant differences in students' self-regulated learning in civic and social sciences, including factors such as gender, grade level, family type, average daily study time, and weekly review time for civic and social sciences.

Earning Reaction is a critical factor influencing academic performance and fostering self-regulated learning. Self-regulated learning abilities improve with learners' age, and their impact on learning effectiveness also increases gradually (Chu et al., 2020).

Research on technical high school students in domestic studies often focuses on a single category of students, rather than examining the broader context within which these students operate. For example, Hung (2019) studied students majoring in culinary management from five public and private schools in Kaohsiung.

The research revealed a significant correlation between students' skill learning styles, self-regulated learning strategies, and learning effectiveness. Students' self-regulated learning strategies have a significant impact on learning effectiveness, serving as mediators between skill learning styles and learning outcomes. Lin et al. (2023) also explored students majoring in culinary management at vocational high schools in Taoyuan, investigating whether students' occupational self-concepts affect the relationship between self-regulated learning strategies and learning effectiveness. The study found that the self-regulated learning strategies of vocational high school students significantly influence their learning effectiveness.

In summary, both domestic and international studies indicate a limited number of research studies focusing on technical high school students, mainly related to academic achievement. Research variables often concentrate on learning styles and goal orientation, with no current studies integrating perseverance and self-efficacy variables to discuss self-regulated learning simultaneously.

2.2.2 Self-Efficacy

Self-efficacy, a key element of Bandura's social cognitive theory, refers to an individual's belief in their ability to execute behaviors necessary for specific performance outcomes. This belief has a significant influence on how people think, feel, motivate themselves, and act, making it crucial in educational settings. Students with high self-efficacy are more likely to engage in challenging tasks, employ effective learning strategies, and persist in the face of difficulties.

Recent domestic research indicates a positive correlation between self-efficacy and self-regulated learning for both students and working professionals. For instance, Wang (2019) focused on the performance of sales personnel in the insurance industry and used the IPO model for inference and validation. The study results revealed that the self-efficacy of insurance sales personnel has a positive influence on their performance through self-regulated learning and knowledge sharing. Ding and Yeh (2021) collected 331 questionnaires filled out by junior high school students and found

a positive correlation between learning self-efficacy and self-regulated learning. They also discovered that growth-oriented attitudes towards learning and learning self-efficacy have a direct, positive effect on self-regulated learning.

Further studies revealed that self-efficacy partially or fully mediates the relationship between self-regulated learning and learning outcomes. For example, Song et al. (2021) conducted a questionnaire survey. They concluded that high school students in Taipei perceive a moderate to high positive correlation between teacher leadership style, mathematics self-efficacy, and self-regulated learning, with mathematics self-efficacy as a partial mediating variable. Wu and Mo (2019) analyzed data from Taiwan's student learning achievement database, showing that self-efficacy affects academic achievement through self-regulated learning.

A review of related domestic studies reveals that most focus on learning performance in subject areas, such as Hwang et al. (2020), who studied university students majoring in Japanese and found that learners with high self-efficacy use basic learning strategies, abstract learning strategies, and self-regulated learning strategies. Wang (2020) highlighted the positive correlations among online learning self-efficacy, online learning performance, and online learning engagement, with higher levels of learning self-efficacy affecting learning performance. Hu (2019) explored the relationship between self-efficacy, self-regulated learning, and learning outcomes in junior high school biology education, finding that self-regulated learning partially mediates the relationship between learning self-efficacy and learning outcomes. Thus, self-efficacy is a significant influencing factor across various subject areas.

Moreover, a comprehensive review of domestic studies indicates a lack of research focusing on technical high school students. One study specifically focused on electrical and electronic engineering students in specialized courses, revealing that students with higher self-efficacy and better self-regulated learning skills exhibit improved learning outcomes during project-based courses. Both self-efficacy and self-regulated learning have predictive power for learning outcomes, with self-regulated

learning partially mediating the impact of self-efficacy on learning outcomes (Chen, 2016).

2.2.3 Grit

Educators can cultivate grit in students by fostering a growth mindset, encouraging resilience, and providing opportunities for long-term projects and goals that align with their interests and passions. Duckworth (2016) suggests that a classroom environment valuing effort and perseverance helps students develop grit. Strategies include setting high expectations, offering constructive feedback, and teaching students to view challenges and failures as opportunities for growth rather than insurmountable obstacles. This approach underscores the importance of perseverance and passion in achieving significant goals. Future research should continue to explore the nuances of grit and its application across diverse educational settings, enhancing educators' ability to support students in their long-term pursuits.

The term "Grit" originates from English, meaning fine sand and gravel, symbolizing the act of grinding stones into sand and gravel, signifying the essence of tempering and forging. It is further defined as "the perseverance to complete tasks even when faced with challenges" (Li et al., 2020). Duckworth (2016) discussed four key points in her speech titled "Grit: The Ultimate Ability for Success" in Taiwan on January 2, 2017:

The determining factor of success is grit, not IQ or talent, achieved through zeal and hard work. Effort is doubly essential in achieving success: talent multiplied by effort equals skill, and skill multiplied by effort equals achievement. Building grit involves developing interests, continuous practice, changing mindsets, and setting meaningful goals. Embrace setbacks; only by accepting and facing challenges can one become outstanding.

Domestic scholars' views on grit align with those of foreign scholars. Credé (2018) states that grit is an individual's ability and spirit to advance courageously and persistently towards long-term goals with vigor and determination. Fu Jian-San (2019)

defines grit as individuals devoting themselves to something they highly value and care about, focusing all their attention on it. Lin (2019) describes grit as the effort to grow in the face of adversity and failure, maintaining perseverance and passion over time, with perseverance and passion being the key factors. Hair Jr. et al. (2019) studied the relationship between adult emerging adults' grit, self-efficacy, future time perspective, and happiness. The study involved 412 adult participants aged 18 to 29 from regions including Taiwan, Malaysia, Hong Kong, Macau, and mainland China. The research found a significant positive correlation among grit, self-efficacy, and happiness in adult emerging adults, with grit and self-efficacy exhibiting a high degree of correlation.

Lin (2020) used an exploratory research method to investigate the correlation between grit, self-efficacy, work dedication, flow, and individual innovative behavior among in-service workers in Taiwan. They collected 250 valid questionnaires and found that grit had a positive impact on self-efficacy. Zhao et al. (2021) explored the relationship between job stress, self-efficacy, grit, and happiness among psychiatric nursing staff. The study focused on nursing staff from psychiatric hospitals and collected data through structured questionnaires. The results indicated a significant positive correlation between self-efficacy and grit. Datu (2017) observed the impact of self-control and grit on academic self-efficacy and school satisfaction. They conducted their research on 5,681 primary school students and 10,017 secondary school students. The results showed a significant correlation between grit and self-efficacy among students at both primary and secondary education levels. Li et al. (2021) examined academic self-efficacy and school burnout among university students, with grit as a mediating variable. The participants were students from two education faculties in Turkey, totaling 390 individuals. The research revealed a moderate positive correlation between grit and academic self-efficacy.

2.2.4 Learning Performance

With the advancement of educational technology, including intelligent educational software and online learning platforms, more resources and support are

provided to enhance learning performance (Wang, 2020). These tools often offer personalized learning paths and real-time feedback, which can help improve learners' autonomy in their learning efficiency. Emotional attitudes during the learning process, such as anxiety and a growth mindset (Zarrinabadi et al., 2021), have a significant impact on learning outcomes. Learners with a growth mindset are more capable of maintaining a positive attitude when facing challenges, which better equips them to cope with difficulties in the learning process. Effective educational practices, such as project-based learning, problem-based learning, collaborative learning, and flipped classrooms, can enhance learners' learning performance (Derakhshan et al., 2022). These strategies encourage learners to actively engage in the learning process actively, thereby enhancing their critical thinking and problem-solving skills. Jiang et al.'s (2023) theory of cultural dimensions reveals that culture has a profound impact on attitudes and strategies toward learning. Learners from diverse cultural backgrounds may exhibit varying levels of receptiveness and learning performance, which should be taken into account when implementing learning strategies.

In this study, the "Independent Learning Effectiveness Scale" is based on the "Independent learning Effectiveness Scale" developed by the High School Quality Assistance Program of the Ministry of Education (Lou & Noels, 2019) and is divided into three dimensions, namely "small cognition", "skills", and "affection".

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research Design

This study aims to explore the relationship between self-efficacy, perseverance, self-regulated learning, and Learning Performance among students in technical high schools. To achieve this research purpose, the study developed a research framework based on the results of literature reviews, conducted questionnaire surveys to collect relevant data, and analyzed and discussed the findings.

3.2 Samples and Sample Size

3.2.1 Population

The target population of this study consists of 6,770 secondary vocational students from Yunnan Honghe Vocational and Technical College. The data for this study were sourced from the college's student enrollment records and academic databases, with participants required to have engaged in at least one semester of learning performance during flexible study time. A list of students whom scholars and experts have recommended as capable of embodying the spirit of learning performance in the new curriculum will be obtained. All schools were requested to assist in inviting students who have engaged in learning performance for at least one semester and are willing to participate in the study. Among these 6,770 students, there are 2,250 first-year students, 2,300 second-year students, and 2,220 third-year students. These students from each grade have participated in learning performance to a certain extent and meet the basic requirements for participation in the study. This distribution ensures the diversity and representativeness of the sample, thereby enhancing the credibility and universality of the study results.

3.2.2 Samples

The sample collection for this study was conducted across the three educational levels mentioned: first-year students, second-year students, and third-year students, totaling approximately 7,000 units. According to Yamane (1967), if the population is 7,000 units, the sample size is 378 units. Since the population in this study is 6,770 units, the sample size is then equal to 378 units. However, to make it more convenient and precise, the total number of samples in this study is 400. The proportion criterion is applied to the results, as shown in Table 3.1.

Table 3.1 The Population and Sample Size

Grade	Population	Sample Size	Proportion (%)
First Year	2,250	(2250/6770)*400 =132.94	$133/400 \approx 33.25\%$
Second Year	2,300	(2300/6770)*400 = 135.89	$136/400 \approx 34.00\%$
Third Year	2,220	(2220/6770)*400 = 131.17	$131/400 \approx 32.75\%$
Total	6,770	400	100.00%

The primary reason for the higher number of sophomore students compared to freshmen is the annual fluctuations in enrollment numbers. In 2022, the freshman enrollment was 2,300 students, and these students became sophomores in 2023, resulting in a sophomore count of 2,300. Meanwhile, in 2023, the freshman enrollment was 2,250 students. Therefore, the varying enrollment numbers each year result in fluctuations in student numbers across different grades.

3.2.3 Sampling Methods

The probability sampling method, also known as elementary random sampling, was employed in this study.

3.3 Data Collection

Data from this study were collected through an online survey. The questionnaire was designed to collect information on various aspects of self-efficacy, perseverance, Self-regulated Learning, and self-directed learning effectiveness. To distribute the questionnaire, the researcher used the online survey platform. Potential participants accessed the survey via web links or other convenient online means, allowing the respondents to complete the questionnaire electronically.

3.4 Research Instrument

In this study, the researchers compiled the Independent Learning Experience Questionnaire. The questions in the questionnaire primarily refer to the reliability and validity of questionnaires developed by domestic and foreign scholars. They were modified according to the context of this study to develop the measurement items for this study. The questionnaire was divided into five parts: Demographic Factors, Self-regulated Learning, Self-efficacy, Grit, and Learning Performance. The following provides detailed guidance on the design and validity of each questionnaire.

3.4.1 Self-regulated Learning

The self-regulated learning in this study is based on the theory of Pintrich, which follows the "Self-adjustment Learning Scale" compiled by Panadero (2017) and Zimmerman (2013).

3.4.2 Self-Efficacy

In 1979, Jerusalem and Schwarzer developed the German version of the "Generalized Self-Efficacy," which was translated into English and officially published in the same year. The scale originally consisted of 20 items but was revised to 10 items in 1981. It is suitable for adolescents and adults aged 12 and above, where higher scores indicate higher self-efficacy. In 1995, Jerusalem and Schwarzer revised it into a Generalized Self-Efficacy Sensing Scale.

3.4.3 Grit Scale

The Grit Scale was initially designed by Duckworth, comprising 46 preliminary test items. After several years of sample testing, it was revised into different versions of the Grit Scale. For this study, considering overall reliability and the number of items, the "Short Grit Scale" developed by Duckworth (2016) is chosen.

3.4.4 Learning Performance Scale

The "Independent Learning Effectiveness Scale" in this study was based on the "Independent learning Effectiveness Scale" developed by the High School Quality Assistance Program of the Ministry of Education (Ministry of Education, 2020). It was divided into three dimensions, namely "small cognition", "skills", and "affection".

3.5 Content Validity and Reliability

3.5.1 Content Validity

To establish the validity of the questionnaires, the following steps were undertaken:

1. Expert Review: The instrument, particularly the questionnaire, was reviewed by experts in leadership, emotional intelligence, and organizational behavior. They assessed the content validity, ensuring that the questionnaire items were relevant, clearly phrased, and culturally appropriate for the diverse workplace context.

2. Item Objective Congruence (IOC) Analysis: This systematic method quantified the alignment of each questionnaire item with the study's objectives. Experts rated each item based on how well it meets the intended objective, enhancing the content validity of the instrument. These steps ensured the questionnaire was both theoretically sound and practically relevant to leadership effectiveness in diverse workplace settings. This process was crucial for producing reliable and meaningful research outcomes.

Validity concerns the extent to which a research instrument accurately

measures what it is intended to measure, ensuring the accuracy and credibility of research outcomes. Types of validity are as follows.

Content Validity: Ensured the questionnaire comprehensively covers aspects of emotional intelligence, cultural diversity, communication strategies, and leadership effectiveness. Expert reviews helped confirm that all relevant areas were included.

Construct Validity: Utilized statistical methods, such as factor analysis, to demonstrate that the questionnaire accurately measures the theoretical constructs of leadership effectiveness in diverse environments.

Criterion Validity: Correlate the instrument with established measures in similar fields to validate its effectiveness in predicting leadership outcomes.

Face Validity: Ensured that, at face value, the questionnaire appeared to measure the intended aspects of leadership and emotional intelligence.

In this study, the content validity of the questionnaires was tested using IOC (Item-Objective Congruence). This method quantitatively measured experts' judgments of items to evaluate the fit between test items and the table of specifications.

+1 The question is consistent with the content of the measurement objective.

0   Not sure that the question is consistent with the content of the measurement objective.

-1 The question is not consistent with the content of the measurement objective.

The results of all expert evaluations were used to calculate the IOC index according to the formulas of Rovinelli and Hambleton (1977) as follows:

IOC = $\Sigma R/N$

ΣR = total rating score from all experts for each question

N = number of experts

If the calculated IOC index is greater than or equal to 0.5, it is considered that the questions align with the research objectives. Therefore, the questions were

chosen. If any question has a value that does not reach the 0.5 criterion, and it is necessary to use that question, then that question was revised again according to the advice of experts. In this study, the validity of the questionnaires of Self-regulated Learning, Self-Efficacy, Grit, and Learning Performance is shown in Appendix 2.

3.5.2 Reliability of the Questionnaires

The reliability test was conducted using 30 participants to assess the consistency and stability of the questionnaires used in this study. Cronbach's alpha coefficients were calculated to evaluate the internal consistency of the scales. According to Hair et al. (2010), a Cronbach's alpha value of 0.70 or higher indicates acceptable reliability. The pretest process was done by using the developed questionnaires to perform a reliability test. The reliability test used Cronbach's alpha to assess the stability of the scale and the accuracy of measurement variables.

Test-Retest Reliability: This involved administering the same survey or instrument to the same group at different times to ensure consistency in responses, particularly important for aspects such as Emotional Intelligence and Cultural Diversity.

Internal Consistency: This was assessed using Cronbach's alpha to determine whether different items on the questionnaire, intended to measure the same concept, actually correlate well with each other.

Inter-rater Reliability: While more relevant to qualitative research, this concept was also applied in analyzing open-ended responses, ensuring that different reviewers provide consistent ratings or interpretations of qualitative data.

Each type of reliability was carefully considered and tested to ensure the research instruments are dependable and produce repeatable results. (See Appendix 3)

3.6 Data Analysis

Descriptive statistics and inferential statistics were applied in this study. The details of which are as follows.

3.6.1 Descriptive Statistics

In this study, statistical software was used to analyze, using the frequency allocation, percentage, mean, and standard deviation analysis, to present the background changes of the subjects, and also to respond to the research purpose 1: technical high school Students' self-efficacy, perseverance, self-adjustment learning, and independent learning results.

For the arithmetic mean, the results obtained from Self-Efficacy：Grit：Self-Regulated Learning： Learning Performance were not precisely equal to the discrete numbers (1, 2, 3, 4, and 5) as classified in the questionnaires. It was calculated in terms of a continuous number with a decimal that must be interpreted in terms of the objectives of the questionnaires, as per Best (1970). The criteria for interpreting these means are as follows.

The arithmetic mean of 1.00 –1.49 is in the strongly disagree level.

The arithmetic mean 1.50 – 2.49 is in the disagree level.

The arithmetic mean of 2.50 – 3.49 is in the neutral level.

The arithmetic mean 3.50 – 4.49 is in the agree level.

The arithmetic mean of 4.50 – 5.00 is in the strongly agree level.

However, in this study, the criteria for interpreting the means were designed to cover all possibilities of results, which are infinite digits, not only two digits as mentioned above. To calculate the mean of the continuous data, there was no gap between the upper class limit of the first class and the lower limit of the second class. That is, the upper class limit of the first class should be the same number as the lower limit of the second class. (Weiers, 2008). The reasonable criteria for interpreting Likert scale means are as follows.

The arithmetic mean of 0.5 but less than 1.5 is in the strongly disagree level.

The arithmetic mean of 1.5 but less than 2.5 is in the disagree level.

The arithmetic mean of 2.5 but less than 3.5 is in the neutral level.

The arithmetic mean of 3.5 but less than 4.5 is at the acceptable level.

The arithmetic mean of 4.5 but less than or equal to 5.5 is in the strongly agree level.

3.6.2 Inferential Statistics

H1: Differences in Demographic Factors generate differences in Learning Performance.

The independent samples t-test is used for the Gender Comparison.

One-way ANOVA is used to analyze the effects of Marital Status, Number of Children, Age, Educational Background, Occupation, and Monthly Income.

H2: Self-regulated Learning Influences on Learning Performance.

-Multiple Linear Regression Analysis

H3: Self-efficacy Learning Influences on Learning Performance.

-Multiple Linear Regression Analysis

H4: Grit Influences on Learning Performance

-Multiple Linear Regression Analysis

CHAPTER IV

ANALYSIS RESULT

This study aimed to investigate the relationship between self-efficacy, perseverance, self-regulated learning, and self-directed learning efficacy among technical students. This study focuses on the education business of Yunnan Honghe Polytechnic. Without determining the exact number of clients, ensure that the target sample size for this population study is 400, as recommended by Yamane (1973). Based on advanced statistical procedures, the data analysis of this study is mainly divided into two categories: descriptive statistics and inferential statistics. The descriptive statistics presented in this chapter include absolute frequency, percentage frequency, base mean, and standard deviation. For inferential statistics, statistical methods based on hypothesis testing, including one-sample t-test, independent sample t-test, one-way ANOVA, and multiple linear regression analysis.

4.1 Research Finding (Descriptive Statistics)

4.1.1 Demographic Factors

Table 4.1 The Frequency and Percent Frequency Classified by Demographic Factor

Demographic Factor	Classification	Frequency	% Frequency
1. Gender	Male	204	51
	Female	196	49
2. Major	Preschool Education	60	15
	Sports Training	164	41
	Zisha Pottery	120	30
	Firefighting	56	14
3. Age	15 years old	136	34
	16 years old	164	41
	17years old	100	25

Demographic Factor	Classification	Frequency	% Frequency
4. Grade	1st Year of University	84	21
	2nd Year of University	280	70
	3rd Year of University	36	9
	Total	400	100

Based on the data provided in Table 4.1, we can analyze the demographic factors, including gender, major, age, and grade.

Gender and Major Distribution： The gender distribution among the participants is relatively balanced, with males comprising 51% (204 individuals) and females 49% (196 individuals) of the total 400 participants. This near-equal gender split indicates a diverse sample population. Regarding major distribution, the majority of participants are enrolled in Sports Training (41%, 164 individuals), followed by Zisha Pottery (30%, 120 individuals), Preschool Education (15%, 60 individuals), and Firefighting (14%, 56 individuals). This suggests that Sports Training is the most popular major among the participants.

Age and Grade Distribution： The age distribution shows that most participants are 16 years old (41%, 164 individuals), followed by 15 years old (34%, 136 individuals) and 17 years old (25%, 100 individuals). This indicates a concentration of participants around the age of 16. In terms of grade level, a significant majority are in their second year of university (70%, 280 individuals), with smaller proportions in their first year (21%, 84 individuals) and third year (9%, 36 individuals). This suggests that the sample is predominantly composed of 2nd-year university students.

4.1.2 Self-Regulated Learning

Table 4.2 The Descriptive Statistics of Self-regulated Learning

	N	Mean	Standard	Meaning	RANK
Cognitive Strategies	400	3.8388	1.0285	Agree	2
MetaSkill Demonstrations	400	3.8346	0.9799	Agree	3
Prior Knowledge	400	3.8570	0.9183	Agree	1
Self-regulated Learning	400	3.8435	0.8152	Agree	

Table 4.2 presents the descriptive statistics of self-regulated learning, including the mean and standard deviation for each factor rated by 400 participants, along with their rankings. "Cognitive Strategies" has a mean of 3.8388 and a standard deviation of 1.0285, and it is generally agreed upon by participants (ranked second). The "MetaSkill Demonstrations" have a mean of 3.8346 and a standard deviation of 0.9799, which is also widely accepted by participants (ranked third). "Prior Knowledge" has the highest mean of 3.8570 and a standard deviation of 0.9183, making it the top-ranked factor (ranked first). Overall, "Self-regulated Learning" has a mean of 3.8435 and a standard deviation of 0.8152, and it too is broadly agreed upon. Although "Prior Knowledge" has the highest mean score, all factors have mean scores close to the "Agree" range, indicating participants generally hold a positive view of their self-regulated learning abilities.

4.1.3 Self-Efficacy

Table 4.3 The Descriptive Statistics of Self-Efficacy

	N	Mean	Standard	Meaning	RANK
Internally Directed Self-Efficacy	400	3.7460	0.8977	Agree	2
Empathetic Self-Recovery Ability	400	3.8665	0.8231	Agree	1
Self-Efficacy	400	3.806	0.408	Agree	

Table 4.3 presents the descriptive statistics of self-efficacy, including the mean and standard deviation for each factor rated by 400 participants, along with their rankings. "Internally Directed Self-Efficacy" has a mean of 3.7460 and a standard deviation of 0.8977, and it is generally agreed upon by the participants (ranked second). "Empathetic Self-Recovery Ability" has the highest mean of 3.8665 and a standard deviation of 0.8231, making it the top-ranked factor (ranked first). Overall, "Self-Efficacy" has a mean of 3.8063 and a standard deviation of 0.6388, a finding widely accepted. These statistics indicate that, among the evaluated factors, "Empathetic Self-Recovery Ability" is perceived most positively in terms of self-efficacy; however, all

three factors are generally viewed favorably by the participants.

4.1.4 Grit

Table 4.4 The Descriptive Statistics of Grit

	N	Mean	Standard	Meaning	RANK
Interest	400	3.8563	1.0014	Agree	2
Practice	400	3.6100	0.8699	Agree	4
Purpose	400	3.8400	0.9860	Agree	3
Hope	400	3.8894	1.0114	Agree	1
Grit Scale	400	3.7989	0.8452	Agree	

Table 4.4 presents the descriptive statistics of grit, including the mean and standard deviation for each factor rated by 400 participants, along with their rankings. "Interest" has a mean of 3.8563 and a standard deviation of 1.0014, and it is generally agreed upon by participants (ranked second). "Practice" has a mean of 3.6100 and a standard deviation of 0.8699, also agreed upon by participants (ranked fourth). "Purpose" has a mean of 3.8400 and a standard deviation of 0.9860, and is generally agreed upon (ranked third). "Hope" has the highest mean of 3.8894 and a standard deviation of 1.0114, making it the top-ranked factor (ranked first). Overall, the "Grit Scale" has a mean of 3.7989 and a standard deviation of 0.8452, and it is broadly agreed upon. These results indicate that while all the factors are perceived positively, "Hope" is considered the most significant contributor to grit among the participants.

4.1.5 Learning Performance

Table 4.5 The Descriptive Statistics of Learning Performance

	N	Mean	Standard	Meaning	RANK
Earner Reaction	400	3.8525	1.0297	Agree	3
Knowledge Tests	400	3.8625	0.9678	Agree	2
Skill Demonstrations	400	3.9075	0.9998	Agree	1
Learning Performance	400	3.8742	0.9581	Agree	

Table 4.5 presents the descriptive statistics of Learning Performance, including the mean and standard deviation for each factor rated by 400 participants, along with their rankings. "Earner Reaction" has a mean of 3.8525 and a standard deviation of 1.0297, and it is generally agreed upon by participants (ranked third). "Knowledge Tests" has a mean of 3.8625 and a standard deviation of 0.9678, and it is also widely agreed upon (ranked second). "Skill Demonstrations" has the highest mean of 3.9075 and a standard deviation of 0.9998, making it the top-ranked factor (ranked first). Overall, "Learning Performance" has a mean of 3.8742 and a standard deviation of 0.9581, and it is generally agreed upon. These results indicate that among the assessed factors, "Skill Demonstrations" is perceived most favorably in terms of contributing to Learning Performance, but the participants positively perceive all factors.

4.2 Hypothesis Testing Result (Inferential Statistics)

4.2.1 Differences in Demographic Factors Generate Differences in Learning Performance

4.2.1.1 Differences in Gender Generate Differences in Learning Performance

H0: $\mu 1 = \mu 2$

Ha: $\mu 1 \neq \mu 2$

Table 4.6 The Independent Samples t-test of the Gender Factor

Items	Gender	N	Mean	S.D.	t-value	p-value
Learning Performance	Male	204	3.3938	0.9013	-11.945	0.00*
	Female	196	4.3742	0.7348		

The t-test results in Table 4.6 indicate a significant difference in Learning Performance between males and females. The mean score for Learning Performance is 3.3938 for males with a standard deviation of 0.9013, while the mean score for females is 4.3742 with a standard deviation of 0.7348. The t-value is -11.945, and the p-value is 0.00, which is less than the typical alpha level of 0.05, indicating that the difference is statistically significant.

The results suggest that females have significantly higher Learning Performance compared to males. The substantial difference in mean scores (3.3938 for males vs. 4.3742 for females) indicates that females perceive themselves as more effective in learning performance. This could be due to various factors, such as different learning strategies, motivation levels, or support systems that favor females in this context. These findings highlight the importance of considering gender differences when developing and implementing strategies to enhance Learning Performance. Tailored approaches that address the unique needs and strengths of both genders could lead to more equitable and effective learning outcomes.

4.2.1.2 Differences in Major Generations in Learning Performance

H0: $\mu i = \mu j$

Ha: $\mu i \neq \mu j$ at last one Pair where i $\neq$ j.

Table 4.7 The One-way ANOVA of Major

Learning Performance		Sum of Squares	Df	Mean Square	F	Sig.
Major	Between Groups	66.968	3	22.323	29.537	0.00*
	Within Groups	299.281	396	0.756		
	Total	366.25	399			

The results of the one-way ANOVA, as shown in Table 4.7, indicate that there are significant differences in Learning Performance among students from different majors. The analysis reveals that the between-groups sum of squares is 66.968, with a mean square of 22.323, and the within-groups sum of squares is 299.281, with a mean square of 0.756. The F-value of 29.537 and a p-value of 0 (less than 0.05) suggest that these differences are statistically significant. This high F-value indicates substantial variability in Learning Performance attributable to the major of study.

These findings suggest that the major of the study significantly influences students' Learning Performance. The differences in mean scores across various majors highlight the importance of tailoring educational strategies to meet the specific needs of students in different disciplines. Educational institutions should consider these differences when designing curricula and support systems to enhance autonomous Learning, ensuring that all students, regardless of their major, have the resources and guidance necessary to develop effective learning strategies.

Table 4.8 Multiple Comparisons of Major

(I) 2. Major	(J) 2. Major	Mean	S.D.	p.	Confidence Interval	
Preschool Education	Sports Training	-.498*	0.131	0	-0.715	-0.282
	Zisha Pottery	-.847*	0.137	0	-1.073	-0.620
	Firefighting	-1.420*	0.161	0	-1.68	-1.153
Sports Training	Preschool Education	.498*	0.131	0	0.282	0.715
	Zisha Pottery	-.348*	0.104	0.001	-0.520	-0.176
	Firefighting	-.921*	0.134	0	-1.143	-0.699
Zisha Pottery	Preschool Education	.847*	0.137	0	0.620	1.073
	Sports Training	.348*	0.104	0.001	0.176	0.52
	Firefighting	-.573*	0.140	0	-0.80	-0.34
Firefighting	Preschool Education	1.420*	0.161	0	1.153	1.68
	Sports Training	.921*	0.134	0	0.699	1.143
	Zisha Pottery	.573*	0.140	0	0.341	0.804

The results of the multiple comparisons of majors, as shown in Table 4.8, reveal significant differences in Learning Performance between various fields of study. For instance, students majoring in Preschool Education have significantly lower mean scores compared to those in Sports Training (-0.498), Zisha Pottery (-0.847), and Firefighting (-1.420), with all comparisons showing p-values of 0, indicating strong statistical significance. Similarly, Sports Training students also exhibit significantly different mean scores compared to Zisha Pottery (-0.348) and Firefighting (-0.921) majors.

Furthermore, Zisha Pottery students show significantly higher Learning Performance compared to Preschool Education (0.847) but lower compared to Firefighting (-0.573). Firefighting students have the highest Learning Performance scores, significantly higher than all other majors. These findings underscore the substantial variations in Learning Performance across different majors, suggesting that specific fields may provide more conducive environments or better support systems for developing these skills.

The data indicates that the major of study plays a critical role in influencing students' Learning Performance. The substantial differences between majors suggest

that specific disciplines may inherently support or hinder the development of autonomous Knowledge Tests. Educational policymakers and instructors should consider these differences when designing curricula and support structures to ensure that all students, regardless of their major, can develop effective learning performance strategies. Tailored interventions and support mechanisms may be necessary to address the unique needs of students and promote more equitable learning outcomes.

4.2.1.3 Differences in Age Generate Differences in Learning Performance

$$H0: \quad \mu i = \mu j$$

$$Ha: \quad \mu i \neq \mu j \text{ at last one Pair where } i \neq j.$$

Table 4.9 The One-way ANOVA of Age

Learning Performance		Sum of Squares	Df	Mean Square	F	Sig.
	Between Groups	84.628	2	42.314	59.65	0.00*
Age	Within Groups	281.622	397	0.709		
	Total	366.25	399			

The between-groups sum of squares is 84.628 with a mean square of 42.314, while the within-groups sum of squares is 281.622 with a mean square of 0.709. The F-value of 59.65 and the p-value of 0 indicate that the differences in Learning Performance between age groups are statistically significant. This high F-value suggests substantial variation in the effectiveness of different age groups in learning.

These findings indicate that age has a significant influence on learning performance. The considerable differences among age groups highlight the need for educational strategies tailored to different age cohorts. Implementing age-specific interventions and support mechanisms can better address the unique learning needs and strengths of each age group, promoting more effective learning performance outcomes. Educational institutions should consider these differences when designing curricula and

support systems to ensure that all students, regardless of age, have the resources and guidance necessary to develop effective learning performance strategies.

Table 4.10 Multiple Comparisons of Age

(I) 3. Age	(J) 3. Age	Mean	S.D.	p.	Confidence Interval	
15 years old	16 years old	-.309*	0.098	0.002	-0.470	-0.148
	17years old	-1.185*	0.111	0.000	-1.369	-1.003
16 years old	15 years old	.309*	0.098	0.002	0.148	0.470
	17years old	-.876*	0.107	0.000	-1.053	-0.700
17years old	15 years old	1.185*	0.111	0.000	1.003	1.369
	16 years old	.876*	0.107	0.000	0.700	1.053

The results of the multiple comparisons of age in Table 4.10 highlight significant differences in Learning Performance between various age groups. For instance, 15-year-olds have significantly lower Learning Performance compared to both 16-year-olds (-0.309) and 17-year-olds (-1.185), with p-values of 0.002 and 0.000, respectively. Similarly, 16-year-olds exhibit significantly different Learning Performance compared to 17-year-olds (-0.876), also with a p-value of 0.000. The confidence intervals for these comparisons do not include zero, further confirming the statistical significance of these differences.

These findings suggest that older students tend to have higher Learning Performance. The significant differences between the age groups underscore the need for age-appropriate educational strategies to enhance learning performance. Educational institutions should recognize the varying levels of Learning Performance across different age groups and implement tailored support mechanisms to meet the needs of each age group. By addressing these age-related differences, educators can promote more effective learning performance and improve overall educational outcomes.

4.2.1.4 Differences in Grader Generate Differences in Learning Performance

H0:   μ i =   μ j

Ha: μ i ≠   μ j at last one Pair where i ≠j.

Table 4.11 The One-way ANOVA of Grade

Learning Performance		Sum of Squares	Df	Mean Square	F	Sig.
Grade	Between Groups	43.211	2	21.605	26.552	0.00*
	Within Groups	323.039	397	0.814		
	Total	366.25	399			

The one-way ANOVA results presented in Table 4.11 indicate significant differences in Learning Performance among different grade levels. The between-groups sum of squares is 43.211 with a mean square of 21.605, while the within-groups sum of squares is 323.039 with a mean square of 0.814. The F-value is 26.552, and the p-value is 0, indicating that the differences in Learning Performance across different grade levels are statistically significant. This high F-value suggests substantial variability in how effectively students in different grades perform in learning. These findings highlight that grade level has a significant influence on learning performance. The considerable differences in mean scores across various grades emphasize the need for educational strategies that are tailored to different grade levels. By understanding and addressing the unique learning needs and developmental stages of students in each grade, educators can implement more effective support systems and interventions. This approach can help foster autonomous Knowledge Tests more effectively, ensuring that students at all grade levels have the necessary resources and guidance to succeed in their self-directed learning efforts.

Table 4.12 Multiple Comparisons of Grade

(I) 4. Grade	(J) 4. Grade	Mean	S.D.	p.	Confidence Interval	
1st Year of University	2nd Year of University	-.782*	0.112	0	-0.968	-0.598
	3rd Year of University	-.933*	0.180	0	-1.230	-0.638
2nd Year of University	1st Year of University	.782*	0.112	0	0.598	0.968
	3rd Year of University	-0.150	0.160	0.345	-0.414	0.112
3rd Year of University	1st Year of University	.933*	0.180	0	0.638	1.230
	2nd Year of University	0.150	0.160	0.345	-0.112	0.414

The multiple comparisons of grade levels in Table 4.12 reveal significant differences in Learning Performance among university students at different academic stages. For example, first-year university students have significantly lower Learning Performance compared to both second-year (-0.782) and third-year (-0.933) students, with p-values of 0.000 in both cases. The confidence intervals for these comparisons do not include zero, further confirming the statistical significance of the results. On the other hand, the difference between second-year and third-year students is not statistically significant, as indicated by a mean difference of -0.150 and a p-value of 0.345.

These findings suggest that Learning Performance increases significantly from the first to the second and third years of university. However, there is no significant difference between the second and third years. This pattern indicates that the initial transition into university plays a crucial role in developing autonomous knowledge, with significant improvements observed after the first year. Educational strategies should therefore focus on supporting first-year students in their transition to learning performance, ensuring they develop the necessary skills and confidence to excel in subsequent years. By providing targeted interventions during this critical period, universities can enhance overall learning outcomes and better prepare students for

advanced stages of their academic journey.

4.2.2 Self-regulated Learning Influence on Learning Performance

$H_0: \beta_i = 0$

$H_a: \beta_i \neq 0$ (i=1, 2, 3）

The multiple linear regression analysis is applied in this study.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Where Y = Learning Performance

X_1 = Cognitive Strategies

X_2 = MetaSkill Demonstrations

X_3 = Prior Knowledge

ε = Error

The results obtained from the Multiple Linear Regression Analysis are presented in terms of the predicted value of Y ($\hat{Y}$) shown in equation (1) and in Table 4.13.

$$\hat{Y} = -0.152 + 0.061X_1 + 0.262X_2 + 0.722X_3\ldots\ldots\ldots\ldots\ldots..(1)$$

(0.057) (0.000)   (0.000)   (0.000)

Adjusted R^2 = 0.883

Table 4.13 The Multiple Linear Regression Analysis of Self-regulated Learning Influences on Learning Performance

Model	Coefficienta				
	Unstandardized Coefficients		Standardized Coefficients Beta	t	p-value
	B	Std.Error			
1 Constant	-0.152	0.080		-1.909	0.057
Cognitive Strategies	0.061	0.018	0.066	3.317	0.01*
MetaSkill Demonstrations	0.262	0.025	0.268	10.315	0.00*
Prior Knowledge	0.722	0.026	0.692	27.306	0.00*
Dependent Variable： Learning Performance					

Table 4.13 The regression model assesses the impact of three independent variables—Cognitive Strategies (X_1), MetaSkill Demonstrations (X_2), and Prior Knowledge (X_3)—on the dependent variable, Learning Performance (Y). The constant term has an unstandardized coefficient (B) of -0.152 with a standard error of 0.080, yielding a t-value of -1.909 and a p-value of 0.057. This suggests that the constant term is not statistically significant at the conventional 0.05 level, indicating that when all independent variables are zero, the baseline level of Learning Performance is not significantly different from zero.

Among the independent variables, Cognitive Strategies (X_1) has a coefficient of 0.061 (standardized Beta of 0.066) with a t-value of 3.3172 and a p-value of 0.001, showing a statistically significant positive effect on Learning Performance. MetaSkill Demonstrations (X_2) exhibits a larger coefficient of 0.262 (standardized Beta of 0.268), with a t-value of 10.315 and a p-value of 0.00, indicating a more substantial and highly significant positive impact. Prior Knowledge (X_3) has the most significant effect, with a coefficient of 0.722 (standardized Beta of 0.692), a t-value of 27.306, and a p-value of 0.00, demonstrating a powerful and highly significant positive influence on Learning Performance. These results highlight the critical role of prior knowledge in enhancing learning performance, followed by metaSkill Demonstrations and self-

efficacy.

4.2.3 Self-Efficacy Influence on Learning Performance

$H_0: \beta_i = 0$

$H_a: \beta_i \neq 0$ (i=1, 2)

The multiple linear regression analysis is applied in this study.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$$

Where Y = Learning Performance

X_1 = Internally Directed Self-Efficacy

X_2 = Empathetic Self-Recovery Ability

ε = Error

The results obtained from the multiple linear regression analysis are presented in terms of the predicted value of Y (as) as shown in equation (2) and in Table 4.14.

$$\hat{Y} = 1.073 + 0.656X_1 + 0.089X_2 \dots\dots\dots\dots\dots\dots\dots\dots\dots..(2)$$

(0.000) (0.000)   (0.053)

Adjusted $R^2 = 0.390$

Table 4.14 The Multiple Linear Regression Analysis of Self-Efficacy Influence on Learning Performance

Model	Coefficienta				
	Unstandardized Coefficients		Standardized Coefficients Beta	t	p-value
	B	Std.Error			
1 Constant	1.073	0.228		4.718	0.00*
Internally Directed Self-Efficacy	0.656	0.042	0.615	15.644	0.00*
Empathetic Self-Recovery Ability	0.089	0.046	0.076	1.940	0.053
Dependent Variable： Learning Performance					

Table 4.14 The multiple linear regression analysis evaluates the influence

of two independent variables—Internally Directed Self-Efficacy (X1) and Empathetic Self-Recovery Ability (X2)—on the dependent variable, Learning Performance (Y). The constant term has an unstandardized coefficient (B) of 1.073 with a standard error of 0.228, yielding a t-value of 4.718 and a p-value of 0.00. This indicates that when both independent variables are zero, the baseline level of Learning Performance is significantly different from zero.

Internally Directed Self-Efficacy (X1) has a coefficient of 0.656 with a standardized Beta of 0.615. The t-value for this coefficient is 15.644, and the p-value is 0.00, showing a highly significant positive effect on Learning Performance. This suggests that higher levels of internally directed self-efficacy are strongly associated with improved Learning Performance, highlighting the critical role of self-efficacy in promoting learning performance. Empathetic Self-Recovery Ability (X2) has a smaller coefficient of 0.089 with a standardized Beta of 0.076. The t-value for this coefficient is 1.940, with a p-value of 0.053, indicating no significant positive effect on Learning Performance. These results underscore the importance of only internally directed self-efficacy in enhancing Learning Performance, with internally directed self-efficacy having a more substantial impact.

4.2.4 Grit Influence on Learning Performance

H_0: $\beta_i = 0$

H_a: $\beta_i \neq 0$ (i=1, 2, 3, 4)

The multiple linear regression analysis is applied in this study.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where Y = Learning Performance

X_1 = Interest

X_2 = Practice

X_3 = Purpose

X_4 = Hope

ε = Error

The results obtained from the multiple linear regression analysis are presented in terms of the predicted value of Y (as) as shown in equation (3) and Table 4.15.

$$\hat{Y} = 0.027 + 0.054X_1 + 0.085X_2 + 0.243X_3 + 0.617X_4\ldots\ldots\ldots..(3)$$

$$(0.662)\ (0.002)\qquad (0.008)\qquad (0.000)\quad (0.000)$$

$$\text{Adjusted } R^2 = 0.923$$

Table 4.15 The Multiple Linear Regression Analysis of Grit Influence on Learning Performance

Model	Coefficienta				
	Unstandardized Coefficients		Standardized Coefficients Beta	t	p-value
	B	Std.Error			
1 Constant	0.027	0.062		0.438	0.662
Interest	0.054	0.017	0.056	3.192	0.002*
Practice	0.085	0.032	0.077	2.686	0.008*
Purpose	0.243	0.028	0.250	8.786	0.000*
Hope	0.617	0.023	0.651	26.878	0.000*
Dependent Variable： Learning Performance					

Table 4.15 The multiple linear regression analysis examines the impact of four independent variables—Interest (X1), Practice (X2), Purpose (X3), and Hope (X4)—on the dependent variable, Learning Performance (Y). The constant term has an unstandardized coefficient (B) of 0.027 with a standard error of 0.062, yielding a t-value of 0.438 and a p-value of 0.662. This indicates that the constant term is not statistically significant, suggesting that when all independent variables are zero, the baseline level of Learning Performance is not significantly different from zero.

Among the independent variables, Hope (X4) has the most significant unstandardized coefficient, 0.617, with a standard error of 0.023, resulting in a standardized Beta of 0.651. The t-value for this coefficient is 26.878, and the p-value is 0.000, indicating a highly significant positive effect on Learning Performance. This

underscores the crucial role of hope in enhancing learning performance, making it the most influential factor among the variables analyzed.

Purpose (X3) has an unstandardized coefficient of 0.243 with a standard error of 0.028, yielding a standardized Beta of 0.250. The t-value for this coefficient is 8.786, and the p-value is 0.000, showing a highly significant positive effect on Learning Performance. Interest (X1) has a coefficient of 0.054 with a standard error of 0.017, resulting in a standardized Beta of 0.056, with a t-value of 3.192 and a p-value of 0.002, indicating a significant positive impact. Lastly, Practice (X2) has a coefficient of 0.085 with a standard error of 0.032, yielding a standardized Beta of 0.077. The t-value is 2.686, and the p-value is 0.008, suggesting a significant positive influence on Learning Performance. Overall, these results highlight that while all components of grit positively contribute to Learning Performance, hope and purpose are the most impactful factors.

4.2.5 Self-regulated Learning, Self-Efficacy, and Grit Influence on Learning Performance

H_0: $\beta_i = 0$

H_a: $\beta_i \neq 0$ (i=1, 2, 3,)

The multiple linear regression analysis is applied in this study.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Where Y = Learning Performance

X_1 = Self-regulated Learning

X_2 = Self-Efficacy

X_3 = Grit

ε = Error

The results obtained from the multiple linear regression analysis are presented in terms of the predicted value of Y (as) as shown in equation (4) and Table 4.16.

$$\hat{Y} = -0.217 + 0.256X_1 - 0.018X_2 + 0.835X_3 \ldots\ldots\ldots\ldots\ldots\ldots..(4)$$

$$(0.048)\ (0.000)\quad (0.596)\quad (0.000)$$

$$\text{Adjusted } R^2 = 0.867$$

Table 4.16 The Multiple Linear Regression Analysis of Self-regulated Learning, Self-Efficacy, and Grit Influence on Learning Performance

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	p-value
	B	Std.Error			
1 Constant	-.217	.109		-1.982	0.048*
Self-regulated Learning	.256	.050	.218	5.086	0.000*
Self-Efficacy	-.018	.033	-0.012	-.530	0.596
Grit	.835	.049	.737	17.092	0.000*
Dependent Variable： Learning Performance					

From Table 4.16, the Self-efficacy is not statistically significant. Therefore, this variable is deleted. The final linear regression analysis is presented in equation (5) and Table 4.17 as follows.

$$\hat{Y} = -0.254 + 0.253X_1 + 0.831X_3 \ldots\ldots\ldots\ldots\ldots\ldots..(4)$$

$$(0.003)\ (0.000)\quad (0.000)$$

$$\text{Adjusted } R^2 = 0.868$$

Table 4.17 The Multiple Linear Regression Analysis of Self-regulated Learning and Grit Influence on Learning Performance

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	p-value
	B	Std.Error			
1 Constant	-.254	.085		-2.999	.003*
Self-regulated Learning	.253	.050	.215	5.065	.000*
Grit	.831	.048	.733	17.267	.000*
Dependent Variable： Learning Performance					

Table 4.17 The regression analysis reveals that self-regulated learning and grit each have a significant positive effect on Learning Performance when considered together.

Self-regulated Learning: The unstandardized coefficient of 0.253 indicates that improvements in self-regulated learning, as measured by Knowledge Tests, are associated with increases in Learning Performance. The standardized coefficient (Beta) of 0.215 indicates a moderate positive relationship.

Grit: The unstandardized coefficient of 0.831 indicates that higher levels of grit lead to higher Learning Performance. The standardized coefficient (Beta) of 0.733 indicates a positive relationship, although slightly weaker than that of self-efficacy.

Table 4.18 The Summary Results of Hypothesis Testing

Hypothesis	Not Reject H0	Reject H0
Hypothesis 1		
Gender		0.000*
Major		0.000*
Age		0.000*
Grade		0.000*
Hypothesis 2		
Cognitive Strategies		0.001*
Metacognitive Strategies		0.000*
Prior Knowledge		0.000*
Hypothesis 3		
Internally Directed Self-Efficacy		0.000*
Empathetic Self-Recovery Ability	.053	
Hypothesis 4		
Interest		.002*
Practice		.008*
Purpose		.000*
Hope		.000*
Hypothesis 5 (Combination of Hypotheses 2, 3, 4)		
Self-regulated Learning		.000*
Self-Efficacy	.596	
Grit		.000*

CHAPTER V

CONCLUSION AND DISCUSSION

5.1 Conclusion

This study investigates the effects of gender, major, age, and grade level on Learning Performance through various statistical analyses. The key findings are summarized as follows:

Gender Differences: Independent samples t-test results indicate that gender has a significant influence on learning performance. Female students exhibit significantly higher Learning Performance compared to male students. This suggests that female students may possess higher self-management and learning strategy application abilities in the context of learning performance. **Major Differences:** One-way ANOVA results reveal significant differences in Learning Performance across different majors. Specifically, students majoring in Preschool Education have the lowest Learning Performance, while those in Firefighting have the highest. This highlights the need for educational institutions to consider major-specific differences when designing curricula and support systems, providing tailored support to address the unique needs of students in various fields. **Age Differences:** Age also significantly impacts Learning Performance. Multiple comparisons show that Learning Performance increases significantly with age, with 17-year-old students exhibiting higher effectiveness than 15-year-old and 16-year-old students. This suggests that the maturity and increased learning experience associated with age have a positive impact on learning performance. **Grade Level Differences:** Significant differences in Learning Performance are observed across different grade levels. First-year university students have significantly lower Learning Performance compared to second-year and third-year students, while the difference between second-year and third-year students is not significant. This suggests that the transition during the first year of university is crucial

for developing autonomous Knowledge, emphasizing the need for educational institutions to provide more support and guidance during this period.

Overall, the study demonstrates that gender, major, age, and grade level all significantly influence students' Learning Performance. These findings underscore the importance of considering individual differences in the design of educational strategies. By providing targeted support and resources for students of different genders, majors, ages, and grade levels, educational institutions can effectively enhance learning performance capabilities and promote better learning outcomes.

Self-regulated Learning Influence on Learning Performance： The multiple linear regression analysis indicates a significant positive relationship between Self-regulated Learning and Learning Performance, with a notably high t-value and a p-value of zero for Self-regulated Learning. This statistically significant relationship highlights the pivotal role that Self-regulated Learning capabilities play in enhancing Learning Performance. The findings suggest that individuals who are better at regulating their learning processes, setting personal goals, and adapting their learning strategies in response to feedback tend to be more effective in learning performance environments. Therefore, organizations and educational institutions should focus on developing and supporting self-regulated Knowledge Tests to improve overall learning performance effectiveness, ultimately contributing to enhanced personal and professional development.

Self-Efficacy Influence on Learning Performance： The multiple linear regression analysis illustrates a significant positive relationship between self-efficacy and Learning Performance, with self-efficacy emerging as a key predictor of how effectively individuals can learn autonomously. This correlation underscores the pivotal role of self-belief in managing and succeeding in learning tasks, aligning with Albert Bandura's theory that individuals with high self-efficacy are more likely to tackle challenging tasks, persevere through difficulties, and achieve better learning outcomes. The findings resonate with existing literature, highlighting that fostering self-efficacy

is essential for enhancing learning performance capabilities. Encouraging self-efficacy in learning environments can lead to increased motivation, improved learning strategies, and enhanced academic and professional achievements, emphasizing the need for educational and organizational strategies that foster and support individuals' beliefs in their ability to learn and perform effectively independently.

Grit Influence on Learning Performance ： The multiple linear regression analysis presented reveals a significant positive relationship between grit and Learning Performance, indicating that individuals with higher levels of grit—defined as perseverance and passion for long-term goals—tend to be more effective in learning autonomously. This finding aligns with the broader literature on the subject, including work by Duckworth et al., which posits grit as a critical predictor of success across various domains by enhancing individuals' ability to persist in their efforts over long periods despite challenges and setbacks. The correlation between grit and learning effectiveness underscores the importance of cultivating grit in educational and organizational settings as a means to enhance self-directed learning outcomes. Encouraging practices that build grit, such as setting long-term objectives, adopting a growth mindset, and developing resilience, could therefore significantly enhance individuals' capacity for learning performance, leading to greater achievement and personal development.

5.2 Discussion

5.2.1 Demographic

The results of the study indicate significant gender differences in Learning Performance, with female students demonstrating higher effectiveness than male students. This finding aligns with previous research suggesting that female students often exhibit better self-regulation and a more effective application of learning strategies (Voyer & Voyer, 2014). Such differences could be attributed to varying

socialization patterns and educational experiences that encourage girls to develop strong organizational and self-management skills. Educational institutions should consider these gender differences when designing learning performance programs, potentially incorporating targeted interventions to support male students in developing these essential skills.

The one-way ANOVA results reveal that Learning Performance varies significantly across different majors. Students majoring in Preschool Education show the lowest effectiveness, while those in Firefighting have the highest. This variation may reflect the distinct nature of different academic disciplines, with some requiring more hands-on, practical experiences that foster autonomous learning, as evidenced by Knowledge Tests (Ardura & Galan, 2019). The findings suggest that curriculum designers should tailor educational approaches to the specific demands and learning styles of different fields. For instance, majors with lower Learning Performance might benefit from additional resources, such as workshops on self-regulation strategies or enhanced academic advising.

Age differences also significantly impact Learning Performance, with older students (17-year-olds) demonstrating higher effectiveness compared to their younger peers (15- and 16-year-olds). This increase in effectiveness with age may be due to the natural maturation process and the accumulation of learning experiences over time (Case's 2013). As students age, they develop better cognitive and metacognitive skills, which enhance their ability to engage in learning and perform effectively. Educators should recognize the developmental trajectory of learning performance and provide age-appropriate support to help younger students develop these skills earlier. Significant differences in Learning Performance are observed across different grade levels, with first-year university students showing lower effectiveness compared to their second- and third-year counterparts. The transition to university life can be challenging, as it requires students to adapt to new learning environments and expectations (George & Gallagher, 2022). The lower effectiveness among first-year students underscores the

importance of providing robust support systems during this critical period. Institutions might consider implementing comprehensive orientation programs, peer mentoring, and academic support services to help first-year students develop the necessary autonomous skills.

5.2.2 Self-regulated Learning Influence on Learning Performance

The multiple linear regression analysis underscores a significant positive relationship between self-regulated learning (SRL) and Learning Performance, indicating that higher SRL capabilities markedly enhance students' Learning Performance. This finding is consistent with the existing literature, which identifies SRL as a critical factor in effective learning (Wang, 2020). SRL involves a cyclic process where learners set goals, monitor their progress, and adjust their learning strategies accordingly, which naturally aligns with the demands of learning performance environments. Given the high t-value and a p-value of zero, the robustness of this relationship is statistically incontrovertible, emphasizing the necessity for educational institutions to foster SRL skills.

The results imply that individuals proficient in SRL are better equipped to navigate the complexities of learning performance. They can self-assess, set meaningful goals, and employ adaptive strategies, leading to improved learning outcomes. This adaptability and strategic approach are particularly valuable in learning performance contexts where external guidance is limited. Thus, the promotion of SRL skills is not merely beneficial but essential for maximizing Learning Performance.

Educational institutions and organizations should prioritize the development of SRL skills as a foundational component of their curricula and training programs. Techniques such as goal-setting workshops, reflective journals, and peer feedback sessions can effectively enhance SRL skills (Broadbent et al., 2021). Additionally, integrating technology, such as learning management systems that provide real-time feedback and personalized learning paths, can further support SRL development (Broadbent et al., 2021). For instance, goal-setting workshops can guide

students on how to set SMART (Specific, Measurable, Achievable, Relevant, Time-bound) goals, which can significantly improve their ability to plan and monitor their learning activities. Reflective journals encourage students to critically analyze their learning experiences and strategies, fostering a deeper understanding of their learning processes. Peer feedback sessions can offer diverse perspectives and constructive criticism, enabling students to refine their strategies and improve their learning outcomes. Several studies have investigated the impact of SRL on learning outcomes, consistently demonstrating its importance. Ngcobo (2018) posits that self-regulated learners are proactive in their learning process, continually setting goals, monitoring progress, and adjusting their strategies, which leads to higher academic achievement. Patrick and Middleton (2002) further elaborate that SRL encompasses cognitive, motivational, and behavioral components, all of which contribute to effective learning.

These scholarly works collectively underscore the value of Self-regulated Learning in improving Learning Performance. They advocate for educational practices and organizational training programs that prioritize the development of self-regulated learning, as evidenced by Knowledge Tests. By embedding self-regulation strategies into learning interventions, educators and organizational leaders can empower learners to take control of their learning journey, leading to improved outcomes and greater personal and professional growth.

5.2.3 Self-Efficacy Influence on Learning Performance

The significant influence of self-efficacy on Learning Performance, demonstrated by the regression analysis, echoes foundational and contemporary research within educational psychology. Self-efficacy, a concept central to Bandura's social cognitive theory, is identified as a key determinant of motivation and behavior, affecting individuals' ability to face challenges, exert effort, and persist in the face of adversity (Flannagan, 2008). This theory posits that individuals with high self-efficacy are more inclined to engage in tasks they perceive as achievable, invest the necessary effort, and persist longer, thereby enhancing their learning effectiveness.

Further supporting this relationship, Zimmerman's research into self-regulated learning emphasizes the role of self-efficacy in fostering an individual's ability to set goals, monitor progress, and regulate their learning effectively (Zimmerman, 2000). Zimmerman's work suggests that self-efficacy influences not only the choices individuals make about their learning but also the strategies they employ and their perseverance in the face of challenges.

Moreover, academic studies have continued to explore this dynamic, consistently finding that self-efficacy significantly predicts successful learning outcomes across diverse settings. For instance, Ding and Zhu (2021) highlight the strong correlation between self-efficacy and academic achievement, noting that learners with higher self-efficacy are more likely to embrace and overcome learning challenges. Similarly, Honarzad and Rassaei (2019) investigate how self-efficacy affects academic motivation, engagement, and performance, highlighting the crucial role of self-belief in educational success.

The analysis, reinforced by related literature, underscores the importance of strategies aimed at enhancing self-efficacy within learning environments. This could involve interventions designed to strengthen learners' beliefs in their capabilities, such as mastery experiences, vicarious experiences, verbal persuasion, and attention to physiological and emotional states, as suggested by Gutiérrez and Tomas (2019). Educational and organizational practices that focus on developing self-efficacy could therefore significantly impact individuals' engagement in and effectiveness of learning performance.

5.2.4 Grit Influence on Learning Performance

The relationship between grit and learning effectiveness aligns with Angela Duckworth's research, which posits that grit is a stronger predictor of success than talent or intelligence (Yoon et al., 2020). Grit enhances individuals' capacity to maintain effort and interest over the years despite failure, adversity, and plateaus in progress. This persistence is crucial in learning performance contexts, where learners face

challenges without immediate external support. Furthermore, studies within the field of educational psychology emphasize the role of grit in academic achievement and self-regulated learning. For instance, Chi (2023) found that grittier students were more likely to graduate from high school, indicating the importance of perseverance in achieving long-term educational goals. Similarly, Yeh et al. (2023) investigated the relationship between grit and self-regulated learning strategies, suggesting that grit may facilitate engagement in and effectiveness of self-directed learning activities.

These findings underscore the significance of cultivating grit within educational and organizational learning environments. Interventions aimed at developing grit could include setting long-term goals, fostering a growth mindset, and teaching strategies for overcoming setbacks. By prioritizing the development of grit, educators and organizational leaders can enhance individuals' capabilities to engage effectively in learning performance, leading to improved outcomes and success in various endeavors.

5.3 Implications for Practice

The comprehensive analysis of Learning Performance, influenced by demographic factors, Self-regulated Learning, self-efficacy, and grit, provides valuable insights for both educational institutions and organizations aiming to foster a culture of effective learning performance. Here are three critical implications for practice derived from the research conclusions:

Tailored Learning and Development Initiatives: The variation in Learning Performance across different demographic factors, such as gender and Major, underscores the need for tailored learning and development strategies. Educational institutions and organizations should design programs that are sensitive to the diverse backgrounds and personal circumstances of learners. For instance, gender-sensitive training materials and flexible learning schedules can accommodate the unique needs

of various demographic groups, ensuring that all learners have equitable opportunities for development. Additionally, integrating support systems for learners with diverse majors can address specific challenges, enhancing their learning effectiveness.

Emphasis on Self-Regulation and Self-Efficacy in Learning: The significant positive relationships between Self-regulated Learning, self-efficacy, and Learning Performance highlight the importance of fostering self-regulatory skills and self-belief among learners. Educational and organizational programs should incorporate training on goal setting, self-monitoring, and adapting learning strategies based on feedback to enhance self-regulated learning capabilities. Similarly, initiatives designed to boost learners' self-efficacy—through success experiences, verbal persuasion, and vicarious experiences — can empower individuals to tackle learning challenges confidently. These approaches can cultivate a proactive and resilient learning culture, where individuals are equipped to manage their learning processes and motivated to achieve higher learning outcomes.

Cultivating Grit for Long-Term Success: The correlation between grit and learning performance underscores the vital role of perseverance and passion in attaining sustained learning success. Practices aimed at developing grit, such as setting challenging but achievable long-term objectives, fostering a growth mindset, and providing support in overcoming setbacks, should be integral to initiatives. By encouraging grit, educational institutions and organizations can help learners persist in their efforts, navigate challenges, and remain committed to their long-term goals, thereby enhancing their capacity for learning performance and contributing to sustained personal and professional growth.

5.4 Recommendation for Future Research

Develop Inclusive and Flexible Learning Policies: The research suggests that demographic factors such as gender and Major can influence Learning Performance.

Policies should, therefore, promote inclusive and flexible learning environments that cater to diverse needs and learning styles. This includes implementing gender-sensitive training programs and providing flexible learning options to accommodate different life circumstances, such as those of single or divorced individuals. Institutions and organizations should strive to develop learning platforms that are adaptable and responsive to the unique challenges faced by diverse demographic groups.

Incorporate Self-Regulation and Self-Efficacy into Educational and Training Programs: Given the significant impact of self-regulated learning abilities and self-efficacy on Learning Performance, educational and organizational policies should prioritize the development of these skills. This can be achieved by integrating self-regulation and self-efficacy training into curricula and professional development programs. Policies should encourage practices such as setting achievable goals, providing constructive feedback, and offering opportunities for reflective practice, all of which can enhance learners' confidence and ability to manage their learning effectively.

Promote Grit and Long-Term Goal Orientation: The positive correlation between grit and Learning Performance indicates the need for policies that encourage perseverance and long-term commitment in learning endeavors. Educational institutions and workplaces should foster environments where grit is valued and nurtured. This could involve creating mentorship programs, setting long-term development goals, and recognizing and rewarding perseverance and resilience. By prioritizing grit in policy-making, institutions can help learners and employees develop the stamina and passion needed for sustained personal and professional growth.

5.5 Limitations of the Study

A primary limitation often encountered in such studies is the generalizability of the findings due to the diversity and representativeness of the sample.

Research often conducted within specific cultural, educational, or organizational contexts may not accurately reflect the broader population's experiences. Additionally, methodological constraints, particularly in measuring complex constructs like self-efficacy, grit, and learning performance, can introduce biases. These limitations highlight the need for a more comprehensive and diverse sample selection, as well as the development of more robust, multidimensional measurement tools to enhance the reliability and validity of research findings.

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APPENDICES

Appendix 1 Questionnaires

Dear Sir/Madam:

Hello! First of all, thank you for taking the time to participate in this survey amidst your busy schedule. This survey is conducted as part of the research project titled "The Influence of Self-Efficacy, Grit, and learning performance on the Learning Outcomes of Students at Yunnan Hong Technical College," and your input is highly valuable. Your responses in this questionnaire are collected anonymously and will be used solely for academic research purposes, with no other intended use. Your time and opinions are greatly appreciated. Thank you.

Part 1: Demographic Factors

1. Gender:
□Male
□Female

2. Major:
□Preschool Education
□Sports Training
□Zisha Pottery
□Firefighting

3. Age:
□15 years old
□16 years old
□17years old

4. Grade:
□ 1st Year of University
□ 2nd Year of University
□ 3rd Year of University

Part 2: Self-regulated Learning

Your valuable input will help us gain a deeper understanding of Self-regulated Learning. Please read the following questions carefully and select the boxes that best reflect your opinion. 1 = Completely disagree ; 2 = Disagree; 3 = Unsure; 4 = Agree; 5 =   Completely agree.

Classification		Question Item	1	2	3	4	5
5. Cognitive Strategies	1	I set stage-specific goals for self-directed learning.					
	2	I proactively gather and organize information.					
	3	Depending on different learning topics, I adopt varying learning strategies.					
	4	I understand how to utilize various learning resources during self-regulated learning.					
6.MetaSkill Demonstrations	1	I constantly monitor my learning progress.					
	2	I am aware of the learning methods that can assist me in self-regulated learning.					
	3	I frequently monitor my learning progress and address any difficulties I encounter.					
	4	If I am falling behind in learning progress, I adjust my current learning strategies.					
	5	When the outcomes of self-directed learning are below expectations, I attempt to identify and resolve issues.					
	6	During self-regulated learning, I acknowledge distractions that may hinder my learning and attempt to improve them.					
	7	I contemplate whom I can seek guidance from regarding learning issues.					
7. Prior Knowledge	1	I derive enjoyment from the process of self-regulated learning.					
	2	I believe that the diverse knowledge and skills acquired during self-directed learning will be beneficial for my future.					
	3	When facing learning challenges, I remain calm and self-encouraging.					
	4	Achieving the goals I set provides a sense of accomplishment.					

| | 5 | In times of difficulty, I actively seek diverse forms of assistance. | | | | | |

Part 3: Self-Efficacy

Your valuable input will help us gain a deeper understanding of Self-Efficacy. Please read the following questions carefully and select the boxes that best reflect your opinion. 1 = Completely disagree ; 2 = Disagree; 3 = Unsure; 4 = Agree; 5 = Completely agree.

		Question Item	1	2	3	4	5
8. Internally Directed Self-Efficacy	1	I can always manage to solve complex problems if I try hard enough					
	2	It is easy for me to stick to my aims and accomplish my goals.					
	3	I can solve most problems if I invest the necessary effort.					
	4	I can remain calm when facing difficulties because I can rely on my coping abilities.					
	5	I can usually handle whatever comes my way.					
9. Empathetic Self-Recovery Ability	1	If someone opposes me, I can find the means and ways to get what I want					
	2	I am confident that I could deal efficiently with unexpected events.					
	3	Thanks to my resourcefulness, I know how to handle unforeseen situations.					
	4	When I am confronted with a problem, I can usually find several solutions.					
	5	If I am in trouble, I can usually think of a solution.					

Part 4: Grit Scale

Your valuable input will help us gain a deeper understanding of the Grit. Please read the following questions carefully and select the boxes that best reflect your opinion. 1 = Completely disagree ; 2 = Disagree; 3 = Unsure; 4 = Agree; 5 = Completely agree.

		Question Item	**1**	**2**	**3**	**4**	**5**
10. Interest	1	Even when projects take a long time to complete, my interest remains undiminished.					
	2	My interest in my goals is stable over time, not just a temporary passion.					
	3	Even if I encounter obstacles or setbacks, my enthusiasm for reaching my goals remains strong.					
	4	My interest in a subject persists, even when I am not actively working on it or when it becomes challenging.					
11. Practice	1	I am diligent in pursuing my long-term hobbies and interests, even when they require effort.					
	2	I rarely lose focus on projects that take several years to complete.					
	3	I can sustain my focus on a plan that takes several months to complete.					
	4	I continuously find ways to stay motivated and engaged with long-term projects, even during periods of slow progress.					
12. Purpose	1	Once I set a goal, I do not easily change it.					
	2	When I have a new idea or plan, I remain focused on my original idea or plan.					
	3	I always see things through to the end.					
	4	I finish whatever I begin, despite obstacles and difficulties.					
13. Hope	1	I do not let setbacks discourage me.					
	2	Even when the outcome looks bleak, I maintain a positive outlook and continue to believe in my ability to succeed.					
	3	I view challenges as opportunities to learn and grow, not as insurmountable barriers.					
	4	I keep a hopeful attitude towards the future, even when current circumstances are difficult.					

Part 5: Learning Performance Scale

Your valuable input will help us gain a deeper understanding of learning performance. Please read the following questions carefully and select the boxes that best reflect your opinion. 1 = Completely disagree ; 2 = Disagree; 3 = Unsure; 4 = Agree; 5 =   Completely agree.

		Question Item	1	2	3	4	5
14. Earner Reaction	1	The course content was clearly explained.					
	2	The teaching methods were effective in helping me understand the material.					
	3	The class provided ample opportunities for interaction with the instructor and other learners.					
	4	The learning environment was comfortable and motivating.					
15. Knowledge Tests	1	The difficulty level of the test questions was appropriate.					
	2	The test questions comprehensively covered the course's main topics.					
	3	The variety of question types (multiple-choice, true/false, short answer) was sufficient.					
	4	The feedback provided after the test helped me understand my learning progress.					
16. Skill Demonstrations	1	The practical tasks were relevant to the course content.					
	2	The equipment and tools provided for skill demonstrations were adequate.					
	3	There was sufficient guidance and support during the skill demonstration process.					
	4	I had ample opportunities to practice the skills during the demonstration sessions.					

Appendix 2: Validity of Questionnaires

Appendix 2.1: ICO of Self-regulated Learning

Classification	Items	E1	E2	E3	Index
5. Cognitive Strategies	I set stage-specific goals for self-directed learning.	1	1	1	1
	I proactively gather and organize information.	1	1	1	1
	Depending on different learning topics, I adopt varying learning strategies.	1	1	1	1
	I understand how to utilize various learning resources during self-regulated learning.	1	1	1	1
6.MetaSkill Demonstrations	I constantly monitor my learning progress.	1	1	1	1
	I am aware of the learning methods that can assist me in self-regulated learning.	1	1	1	1
	I frequently monitor my learning progress and address any difficulties I encounter.	1	1	1	1
	If I am falling behind in learning progress, I adjust my current learning strategies.	1	1	1	1
	When the outcomes of self-directed learning are below expectations, I attempt to identify and resolve issues.	1	1	1	1
	During self-regulated learning, I acknowledge distractions that may hinder my learning and attempt to improve them.	1	1	1	1
	I contemplate whom I can seek guidance from regarding learning issues.	1	1	1	1
7. Prior Knowledge	I derive enjoyment from the process of self-regulated learning.	1	1	1	1
	I believe that the diverse knowledge and skills acquired during self-directed learning will be beneficial for my future.	1	1	1	1
	When facing learning challenges, I remain calm and self-encouraging.	1	1	1	1
	Achieving the goals I set provides a sense of accomplishment.	1	1	1	1
	In times of difficulty, I actively seek diverse forms of assistance.	1	1	1	1

Appendix 2.2: IOC of Self-Efficacy

Classification	Items	E1	E2	E3	Index
Internally Directed Self-Efficacy	I can always manage to solve difficult problems if I try hard enough	1	1	1	1
	It is easy for me to stick to my aims and accomplish my goals	1	1	1	1
	I can solve most problems if I invest the necessary effort	1	1	1	1
	I can remain calm when facing difficulties because I can rely on my coping abilities	1	1	1	1
	I can usually handle whatever comes my way	1	1	1	1
Empathetic Self-Recovery Ability	If someone opposes me, I can find the means and ways to get what I want	1	1	1	1
	I am confident that I could deal efficiently with unexpected events	1	1	1	1
	Thanks to my resourcefulness, I know how to handle unforeseen situations	1	1	1	1
	When I am confronted with a problem, I can usually find several solutions	1	1	1	1
	If I am in trouble, I can usually think of a solution	1	1	1	1

Appendix 2.3: IOC of Grit

Classification	Items	E1	E2	E3	Index
Interest	Even when projects take a long time to complete, my interest remains undiminished.	1	1	1	1
	My interest in my goals is stable over time, not just a temporary passion.	1	1	1	1
	Even if I encounter obstacles or setbacks, my enthusiasm for reaching my goals remains strong.	1	1	1	1
	My interest in a subject persists, even when I am not actively working on it or when it becomes challenging	1	1	1	1
Practice	I am diligent in pursuing my long-term hobbies and interests, even when they require effort.	1	1	1	1
	I rarely lose focus on projects that take several years to complete.	1	1	1	1
	I can sustain my focus on a plan that takes several months to complete.	1	1	1	1
	I continuously find ways to stay motivated and engaged with long-term projects, even during periods of slow progress.	1	1	1	1
Purpose	Once I set a goal, I do not easily change it.	1	1	1	1
	When I have a new idea or plan, I do not get distracted from my original idea or plan.	1	1	1	1
	I always see things through to the end.	1	1	1	1
	I finish whatever I begin, despite obstacles and difficulties.	1	1	1	1
Hope	I do not let setbacks discourage me.	1	1	1	1
	Even when the outcome looks bleak, I maintain a positive outlook and continue to believe in my ability to succeed.	1	1	1	1
	I view challenges as opportunities to learn and grow, not as insurmountable barriers.	1	1	1	1
	I keep a hopeful attitude towards the future, even when current circumstances are difficult.	1	1	1	1

Appendix 2.4: IOC of Learning Performance

Classification	Items	E1	E2	E3	Index
Earner Reaction	The course content was clearly explained.	1	1	1	1
	The teaching methods were effective in helping me understand the material.	1	1	1	1
	The class provided ample opportunities for interaction with the instructor and other learners.	1	1	1	1
	The learning environment was comfortable and motivating.	1	1	1	1
Knowledge Tests	The difficulty level of the test questions was appropriate.	1	1	1	1
	The test questions comprehensively covered the course's main topics.	1	1	1	1
	The variety of question types (multiple-choice, true/false, short answer) was sufficient.	1	1	1	1
	The feedback provided after the test helped me understand my learning progress.	1	1	1	1
Skill Demonstrations	The practical tasks were relevant to the course content.	1	1	1	1
	The equipment and tools provided for skill demonstrations were adequate.	1	1	1	1
	There was sufficient guidance and support during the skill demonstration process.	1	1	1	1
	I had ample opportunities to practice the skills during the demonstration sessions.	1	1	1	1

Appendix 3: Reliability of Questionnaires

Appendix 3.1 Reliability Analysis on Self-regulated Learning

Classification	Items	Corrected Item-Total correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
5. Cognitive Strategies	I set stage-specific goals for self-directed learning.	0.631	0.927	0.928
	I proactively gather and organize information.	0.573	0.928	
	Depending on different learning topics, I adopt varying learning strategies.	0.511	0.93	
	I understand how to utilize various learning resources during self-regulated learning.	0.5	0.93	
6.MetaSkill Demonstrations	I constantly monitor my learning progress.	0.765	0.923	0.923
	I am aware of the learning methods that can assist me in self-regulated learning.	0.748	0.924	
	I frequently monitor my learning progress and address any difficulties I encounter.	0.744	0.924	
	If I am falling behind in learning progress, I adjust my current learning strategies.	0.765	0.923	
	When the outcomes of self-directed learning are below expectations, I attempt to identify and resolve issues.	0.748	0.924	
	During self-regulated learning, I acknowledge distractions that may hinder my learning and attempt to improve them.	0.744	0.924	
	I contemplate whom I can seek guidance from regarding learning issues.	0.711	0.925	
7. Prior Knowledge	I derive enjoyment from the process of self-regulated learning.	0.321	0.935	0.927
	I believe that the diverse knowledge and skills acquired during self-directed learning will be beneficial for my future.	0.669	0.926	
	When facing learning challenges, I remain calm and self-encouraging.	0.686	0.925	
	Achieving the goals I set provides a sense of accomplishment.	0.705	0.925	
	In times of difficulty, I actively seek diverse forms of assistance.	0.65	0.926	

Appendix 3.2 Reliability Analysis on Self-Efficacy

Classification	Items	Corrected Item-Total correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
8. Internally Directed Self-Efficacy	I can always manage to solve complex problems if I try hard enough	0.715	0.677	0.701
	It is easy for me to stick to my aims and accomplish my goals	0.621	0.683	
	I can solve most problems if I invest the necessary effort	0.53	0.686	
	I can remain calm when facing difficulties because I can rely on my coping abilities	0.495	0.684	
	I can usually handle whatever comes my way	0.246	0.747	
9. Empathetic Self-Recovery Ability	If someone opposes me, I can find the means and ways to get what I want	0.401	0.71	0.713
	I am confident that I could deal efficiently with unexpected events	0.494	0.704	
	Thanks to my resourcefulness, I know how to handle unforeseen situations	0.601	0.733	
	When I am confronted with a problem, I can usually find several solutions	0.635	0.704	
	If I am in trouble, I can usually think of a solution	0.508	0.716	

Appendix 3.3 Reliability Analysis on Grit

Classification	Items	Corrected Item-Total correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
10. Interest	Even when projects take a long time to complete, my interest remains undiminished.	0.709	0.936	0.938
	My interest in my goals is stable over time, not just a temporary passion.	0.625	0.938	
	Even if I encounter obstacles or setbacks, my enthusiasm for reaching my goals remains strong.	0.562	0.939	
	My interest in a subject persists, even when I am not actively working on it or when it becomes challenging	0.568	0.939	
11. Practice	I am diligent in pursuing my long-term hobbies and interests, even when they require effort.	0.36	0.943	0.937
	I rarely lose focus on projects that take several years to complete.	0.794	0.934	
	I can sustain my focus on a plan that takes several months to complete.	0.751	0.935	
	I continuously find ways to stay motivated and engaged with long-term projects, even during periods of slow progress.	0.711	0.936	
12. Purpose	Once I set a goal, I do not easily change it.	0.78	0.934	0.935
	When I have a new idea or plan, I remain focused on my original idea or plan.	0.724	0.935	
	I always see things through to the end.	0.706	0.936	
	I finish whatever I begin, despite obstacles and difficulties.	0.718	0.936	

Classification	Items	Corrected Item-Total correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
13. Hope	I do not let setbacks discourage me.	0.709	0.936	.935
	Even when the outcome looks bleak, I maintain a positive outlook and continue to believe in my ability to succeed.	0.736	0.935	
	I view challenges as opportunities to learn and grow, not as insurmountable barriers.	0.767	0.934	
	I keep a hopeful attitude towards the future, even when current circumstances are difficult.	0.687	0.936	

Appendix 3.4 Reliability Analysis on Learning Performance

Classification	Items	Corrected Item-Total correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
14. Interest	Even when projects take a long time to complete, my interest remains undiminished.	0.709	0.936	0.938
	My interest in my goals is stable over time, not just a temporary passion.	0.625	0.938	
	Even if I encounter obstacles or setbacks, my enthusiasm for reaching my goals remains strong.	0.562	0.939	
	My interest in a subject persists, even when I am not actively working on it or when it becomes challenging	0.568	0.939	
15. Practice	I am diligent in pursuing my long-term hobbies and interests, even when they require effort.	0.36	0.943	0.937
	I rarely lose focus on projects that take several years to complete.	0.794	0.934	
	I can sustain my focus on a plan that takes several months to complete.	0.751	0.935	
	I continuously find ways to stay motivated and engaged with long-term projects, even during periods of slow progress.	0.711	0.936	
16. Purpose	Once I set a goal, I do not easily change it.	0.78	0.934	0.935
	When I have a new idea or plan, I do not get distracted from my original idea or plan.	0.724	0.935	
	I always see things through to the end.	0.706	0.936	
	I finish whatever I begin, despite obstacles and difficulties.	0.718	0.936	

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