Journal of Education and Learning; Vol. 14, No. 1; 2025
ISSN 1927-5250 E-ISSN 1927-5269
Published by Canadian Center of Science and Education

Improving Vocational and Technical Education: Comparing Flipped and Traditional Classrooms' Impact on Learning Performance in Management Courses

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Received: June 20, 2024 Accepted: August 16, 2024 Online Published: September 15, 2024

doi:10.5539/jel.v14n1p132 URL: https://doi.org/10.5539/jel.v14n1p132

Abstract

This essay examines the effectiveness of flipped classroom approaches in improving learning outcomes among first-year management students at Chinese vocational colleges. Using a quasi-experimental design, the study involved fifty classes with a total of 1,000 students, divided into experimental and control groups. The study aimed to evaluate how the flipped classroom model influences academic achievement, analytical, creative, and practical intelligence, as well as learning attitudes. It also investigated whether cognitive styles (visual vs. verbal orientation) moderated the relationship between teaching methods and learning outcomes. Results show that the flipped classroom significantly enhances cognitive learning achievements, analytical, creative, and practical intelligence, and fosters a more positive learning attitude compared to traditional methods. Notably, cognitive styles had a minimal impact on learning outcomes, suggesting that the benefits of flipped classrooms apply broadly across different learning preferences. This research enhances the understanding of effective pedagogical strategies in vocational education and underscores the flipped classroom's potential to improve student learning experiences.

Keywords: flipped classroom, vocational and technical colleges, learning performance, cognitive styles

1. Introduction

Vocational education is vital for workforce needs and economic growth, varying globally to match different economic and social contexts (Li & Pilz, 2023). In China, vocational education has evolved from ancient artisan traditions to modern forms influenced by Western models in the early 20th century (Ling, Chung, & Wang, 2023). However, traditional teaching methods in these institutions often struggle to meet diverse student needs and workplace demands.

The limitations of traditional lecture-based approaches are increasingly recognized, as they often fail to develop critical thinking and problem-solving skills needed in today's job market (Hafeez, 2021). The flipped classroom model, which emphasizes active learning and practical application, is a promising alternative (Hake, 2022). In this model, students engage with new material outside the classroom through digital content, while classroom time is used for interactive, problem-solving activities (Jaiswal, 2021; Martins, 2020).

This study explores the efficacy of flipped classrooms for first-year management students in Chinese vocational colleges, examining their impact on academic achievement, cognitive abilities, and learning attitudes. Despite its benefits, the flipped classroom model is not widely adopted in Chinese vocational education, which remains dominated by lectures and passive learning (Lai, Lin, & Yueh, 2020; Liu & Zhang, 2022). This approach often fails to engage all students effectively or cater to their diverse cognitive styles, which are crucial for personalized learning and effective education (George et al., 2022; Evendi et al., 2022).

Research questions include:

1) Differences in learning performance before and after traditional classroom instruction.

2) Differences in learning performance before and after flipped classroom instruction.

3) Whether cognitive style moderates the relationship between demographics and learning performance in

traditional classroom instruction.

4) Whether cognitive style moderates the relationship between demographics and learning performance in flipped classroom instruction.

Hypotheses:

H1o: The mean difference in academic test scores before and after based on traditional classroom instruction is zero in the population.

H1a: The mean difference in academic test scores before and after based on traditional classroom instruction is not equal to zero.

H2o: The mean difference in successful intelligence scores before and after based on traditional classroom instruction is zero in the population.

H2a: The mean difference in successful intelligence scores before and after based on traditional classroom instruction is not equal to zero.

H3o: The mean difference in learning attitude test scores before and after based on traditional classroom instruction is zero in the population.

H3a: The mean difference in learning attitude test scores before and after based on traditional classroom instruction is not equal to zero in the population.

H4o: The mean difference in academic test scores before and after flipped classroom instruction is zero in the population.

H4a: The mean difference in academic test scores before and after flipped classroom instruction is not equal to zero in the population.

H5o: The mean difference in successful intelligence scores before and after based on flipped classroom instruction is zero in the population.

H5a: The mean difference in successful intelligence scores before and after based on flipped classroom instruction is not equal to zero in the population.

H6o: The mean difference in learning attitude test scores before and after based on flipped classroom instruction is zero in the population.

H6a: The mean difference in learning attitude test scores before and after based on flipped classroom instruction is not equal to zero in the population.

H7o: Cognitive Style does not moderate the relationship between selected demographic profile (College, Gender) and Learning Performance for traditional classroom instruction.

H7a: Cognitive Style moderates the relationship between selected demographic profile (College, Gender) and Learning Performance for traditional classroom instruction.

H8o: Cognitive Style does not moderate the relationship between selected demographic profile (College, Gender) and Learning Performance for flipped classroom instruction.

H8a: Cognitive Style moderates the relationship between selected demographic profile (College, Gender) and Learning Performance for flipped classroom instruction.

By addressing these gaps, this study aims to enhance vocational education's quality and relevance for management students in China.

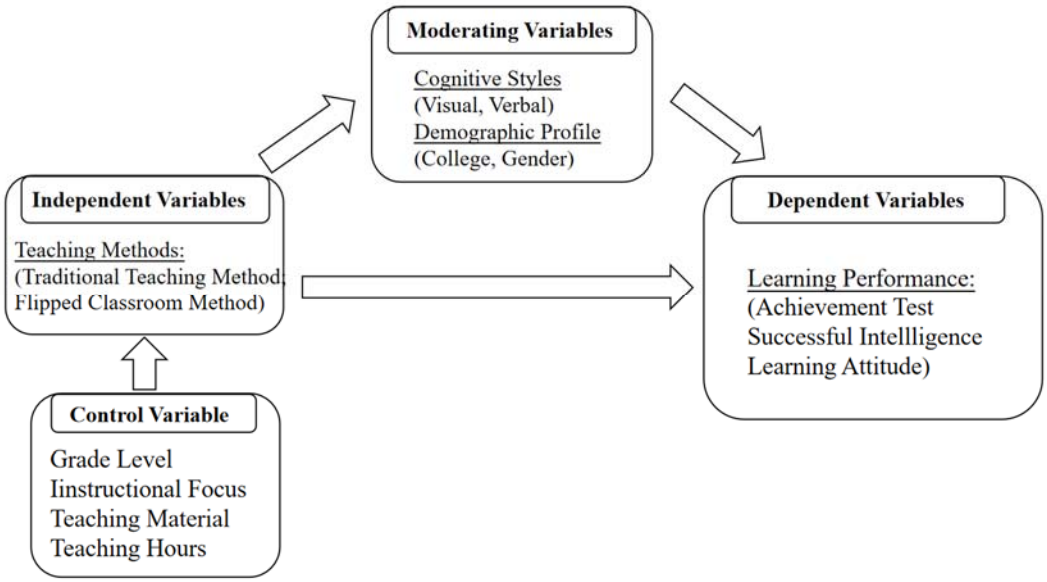

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Figure 1. Conceptual framework

2. Literature Review

2.1 Flipped Classroom

The flipped classroom model represents a significant departure from traditional teaching methods and has gained increasing recognition in educational innovation (Tang et al., 2023; Galindo-Dominguez, 2021). Ahmed (2016) describes the flipped classroom as more of a philosophical shift than just a teaching technique (Gnutova, 2020). The term "flipped" refers to reversing the traditional learning model: students engage in active learning, blended course design, and podcast-based classes. According to Sams and Bergmann (2013), "flipping" combines emerging technologies to move away from the conventional model of in-class lectures followed by homework (Ozdamli & Asiksoy, 2016). Instead, students use computers, tablets, and mobile devices to review pre-recorded videos or materials before class, allowing them to learn at their own pace and revisit content as needed. In-class time is then dedicated to discussions, projects, or exercises, emphasizing interaction between students and lecturers (Mandasari & Wahyudin, 2021).

In this model, lecturers shift from being the central figure to acting as coaches or advisors, facilitating independent and collaborative learning (Awidi & Paynter, 2019). The implementation involves two main stages: (a) Preparation Before Class, where lecturers create or select course materials, enabling students to actively participate in class discussions and activities (Rasheed et al., 2020; Mojtahedi et al., 2020). Pre-class assignments help lecturers assess students' initial understanding and progress (Santos & Serpa, 2020). (b) Classroom Time, where focuses on collaborative learning activities, such as presentations, discussions, and Q&A sessions (Youhasan et al., 2021). With basic concepts covered in pre-class study, lecturers can engage students in more advanced cognitive learning aligned with educational goals (Santos & Serpa, 2020).

Advocates of the flipped classroom believe it promotes student self-learning and enhances lecturer-student interaction through face-to-face feedback (Jiang et al., 2022). While not a cure-all for teaching challenges, it maximizes classroom learning opportunities, aligning with the core spirit of education (Reidsema et al., 2017).

However, the literature highlights the variability in the implementation of flipped classrooms, which complicates efforts to generalize its efficacy (Nja et al., 2022). Additionally, there is limited research on the flipped classroom's impact on vocational and technical education, especially in non-Western contexts (Torres-Martín et al., 2022).

2.2 Learning Performance

Learning performance refers to changes in learners' knowledge, skills, and attitudes following a learning activity (Law, Geng, & Li, 2019). It encompasses both narrow definitions, like academic performance and grades (Lynch & Hennessy, 2017), and broader definitions, including overt behavior, emotions, and cognition that interact to influence enduring performance (Schwab, Moseley, & Dustin, 2018).

According to Giannakos (2013), learning performance includes both immediate 'direct learning performance' and long-term 'indirect learning performance' that affect future development. Qureshi et al. (2023) emphasize assessing the effectiveness of cognitive, affective, and skills learning processes during education.

Academic achievement involves lecturers assessing students' knowledge and skills from learning tasks, which helps adjust teaching methods (Aljaser, 2019; Demir & Seferoğlu, 2019). Analytical intelligence involves judging and evaluating problem-solving methods and ideas, encompassing abilities like analysis, critique, and evaluation (Sternberg & Grigorenko, 2002). Creative intelligence pertains to handling novel situations, identifying problems, and devising solutions, including discovery, creativity, and invention (Sternberg, 1997; Sternberg & Grigorenko, 2002). Practical intelligence is about adapting to and managing everyday life problems, involving application and implementation skills (Sternberg & Clinkenbeard, 1995).

These types of intelligence interact across information processing, experiences, and contexts (Sternberg et al., 1999). Learning performance is influenced by the interplay of cognition, emotion, and action intentions (Hwang & Chang, 2011). Understanding learners' attitudes helps predict their reactions (McAuley, Leskovec, & Jurafsky, 2012), with "learning attitude" referring to consistent behavioral tendencies developed during the study (McAuley et al., 2012).

2.3 Cognitive Styles in Flipped Classroom Approaches

Cognition, as noted by Riding (2014), is the psychological process through which individuals consciously understand and comprehend their surroundings. Cognitive psychology uses Information Processing Theory to study how people absorb and apply cognitive processes through activities like sensory perception, memory, identification, attention, and transformation (Steichen & Fu, 2020). Cognitive style refers to an individual's habitual characteristics and traits in thinking, understanding, and processing information. These traits are stable and do not significantly change over time or across different environments (Riding & Cheema, 1991).

Cognitive style types denote an individual's preferred way of processing information, independent of intelligence (Weller et al., 2020). Riding and Cheema (1991) categorized cognitive styles into two major groups: 'Wholist-Analytic Style' and 'Verbalizer-Imager Style,' based on response times in tests. Common cognitive styles include Visualizer vs. Verbalizer, Field-Independent vs. Field-Dependent, and High Conceptual Level vs. Low Conceptual Level.

With the rise of multimedia technology in internet-based teaching, cognitive styles significantly influence learners' preferences for multimedia content (Ghinea & Chen, 2003). For instance, individuals with a Visualizer/Verbalizer cognitive style prefer processing visual or verbal information, respectively (Jonassen & Grabowski, 2012). Recognizing individual differences in information processing is crucial in discussions about cognitive styles (Ke et al., 2023).

While studying cognitive styles offers valuable insights into personalized education, the literature often outpaces empirical evidence. Measurement challenges, variability in findings, and the need for comprehensive research designs persist. Future studies should employ rigorous methodologies, explore the interaction of cognitive styles with other learner characteristics, and investigate how pedagogical models like the flipped classroom can accommodate diverse cognitive styles in vocational and technical education settings.

2.4 Theoretical Framework

This study's theoretical framework is carefully crafted to address the problem statement, integrating theories from educational psychology and pedagogical approaches to explore the potential of the flipped classroom model in vocational and technical education. By aligning each theory with specific aspects of the problem, the framework guides the research methodology and ensures that the study's findings are interpreted within a coherent, theoretically informed context.

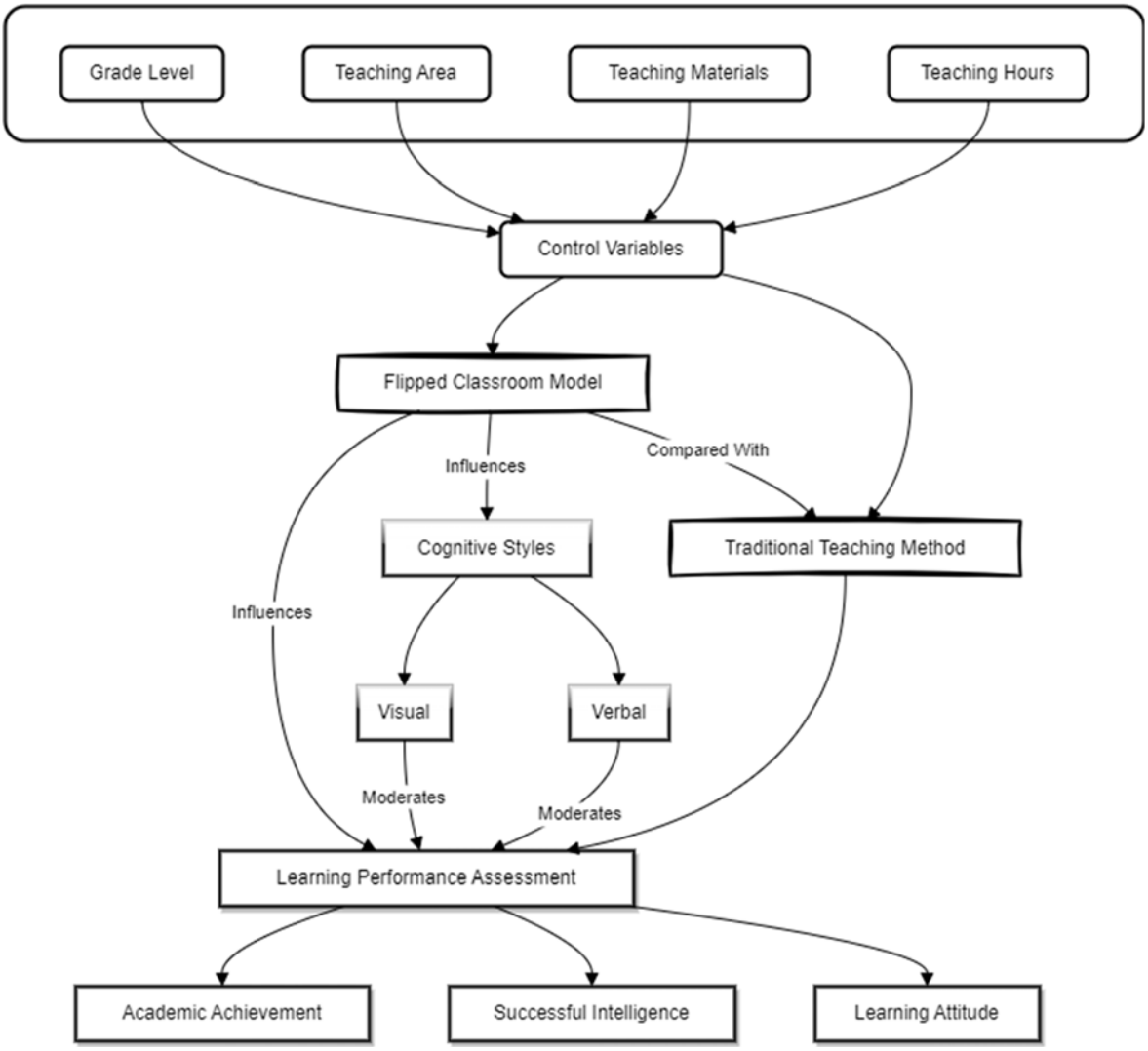

Figure 2. Theoretical framework

This study uses a mixed-methods approach to evaluate the effectiveness of flipped classroom methods in enhancing learning outcomes among first-year management students in vocational colleges in Anhui Province, China. It combines quantitative and qualitative data collection and analysis to provide a thorough understanding of the research questions.

3. Methodology

3.1 Research Design

A quasi-experimental design compares outcomes between an experimental group using flipped classrooms and a control group using traditional teaching methods. This design is ideal for educational settings where random assignment is impractical, allowing for the assessment of causal relationships while controlling for confounding variables.

Table 1. Quasi-experimental research design

Group	Pre-test	Experimental Treatment	Post-test
Experimental Group	T1	G1	T2
Control Group	T3	G2	T4

Note. G1: Flipped classroom teaching; G2: Traditional teaching; T1, T3: Pre-test (Achievement Test, Analytical, Creative, and Practical Intelligence, Learning Attitude; T2, T4: Post-test (Achievement Test, Analytical, Creative, and Practical Intelligence, Learning Attitude.

3.2 Participants

The study includes 1000 first-year management students from five vocational colleges in Anhui Province, China. Approximately 500 students are assigned to the experimental group and 500 to the control group, selected based on their enrollment in management courses during the academic year.

3.3 Experimental and Control Groups

Participants are divided into an experimental group and a control group. The experimental group receives flipped classroom instruction, while the control group follows traditional teaching methods. Convenience sampling ensures an equal number of students from each college in both groups.

3.4 Intervention

In the experimental group, the flipped classroom approach is the primary instructional method. Students review pre-class materials (video lectures, readings, interactive multimedia) independently before class. In-class time is used for active learning activities, discussions, problem-solving tasks, and hands-on applications. The control group receives traditional instruction with instructor-led lectures and textbook readings. The process of the study is illustrated in Figure 3.

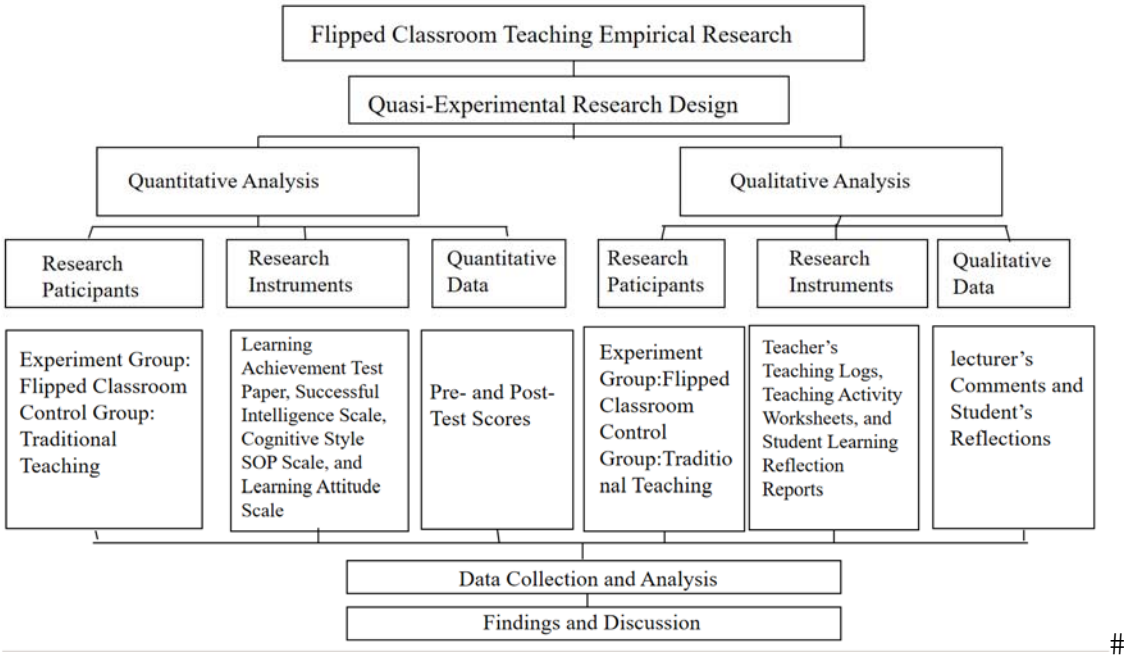

Figure 3. Empirical research process

3.5 Data Collection

Data collection includes both quantitative and qualitative measures.

Quantitative Measures:

1) Standardized tests: Pre- and post-tests assess academic achievement.

2) Surveys: Measure student attitudes towards learning, including motivation, engagement, and satisfaction.

Qualitative Measures:

1) Observations: Capture student engagement, participation, and interactions.

2) Interviews: Gather insights from students and instructors about their experiences and perceived impacts on learning outcomes.

3.6 Data Analysis

Quantitative data from tests and surveys are analyzed using descriptive statistics (means, standard deviations) and inferential statistics (t-tests, ANOVA). Qualitative data from observations and interviews are analyzed

thematically to identify patterns and themes.

3.7 Validity and Reliability

Several measures ensure validity and reliability:

Internal Validity: Enhanced by careful participant selection and matching, and using standardized tests and surveys.

External Validity: Enhanced by including participants from multiple colleges, increasing generalizability.

Reliability: Ensured through established measurement instruments and rigorous data collection and analysis procedures.

4. Findings

This part explores the effects of traditional versus flipped classroom instructional methods on learning performance in vocational and technical education (VTE), focusing on academic achievement, successful intelligence, and learning attitudes. Additionally, it examines the moderating role of cognitive style in the relationship between demographic profiles and learning outcomes.

4.1 Quantitative Findings

4.1.1 Academic Achievement

The study demonstrated that the flipped classroom model significantly outperforms traditional methods in enhancing academic achievement. Students in the flipped classroom (experimental group) exhibited a mean increase of 41.642 points in academic achievement test scores, compared to a 30.998-point increase in the traditional classroom (control group). This statistically significant difference highlights the superior effectiveness of the flipped classroom approach in improving students' academic performance.

4.1.2 Successful Intelligence

In terms of successful intelligence—encompassing analytical, creative, and practical skills—the flipped classroom model again showed notable advantages. The experimental group experienced a substantial mean increase of 8.888 points in successful intelligence scores, while the control group showed a negligible decrease of 0.072 points. Independent sample t-tests confirmed that the flipped classroom significantly enhances successful intelligence, demonstrating its efficacy in developing critical cognitive skills.

4.1.3 Learning Attitudes

The flipped classroom also led to a significant improvement in learning attitudes. Students in this model showed a mean increase of 33.214 points in learning attitude scores, while the control group experienced a minor, non-significant decrease of 0.39 points. This indicates that the flipped classroom model effectively promotes a more positive attitude towards learning, increasing student motivation, interest, and engagement.

4.1.4 Moderating Role of Cognitive Style

The study investigated whether cognitive style moderates the relationship between demographic profiles (e.g., college, gender) and learning performance. Hierarchical regression analyses revealed that cognitive style did not significantly moderate these relationships for either instructional method. This suggests that the positive effects of the flipped classroom model on learning performance are consistent across different cognitive styles and demographic groups.

4.2 Qualitative Insights

In addition to quantitative analysis, qualitative data were collected to provide deeper insights into the experiences and perceptions of students and teachers in both instructional settings. This qualitative component included teaching records, activity worksheets, and reflection reports.

4.2.1 Teacher Observations

Teachers observed that the flipped classroom approach allowed for more dynamic and interactive lesson plans, which improved student participation. In contrast, traditional methods often resulted in a more passive learning environment. The flipped classroom model facilitated increased student engagement and interaction, leading to a more effective learning experience.

4.2.2 Student Experiences

Students in the flipped classroom reported a better understanding and retention of course material, attributing this to the ability to review content at their own pace before class. This was contrasted with the traditional classroom, where the one-size-fits-all lecture format led to varying levels of comprehension and engagement. The flipped

classroom model fostered a sense of responsibility for their own education, leading to increased motivation and enthusiasm.

4.2.3 Learning Attitudes

Both students and teachers noted that the flipped classroom model promoted a more positive attitude towards learning. Students felt more engaged and responsible for their learning, while traditional settings often left students feeling disengaged. The flipped classroom's emphasis on active learning and collaboration contributed to improved attitudes and greater motivation.

4.3 Summary and Implications

Overall, the findings underscore the significant advantages of the flipped classroom model over traditional methods in enhancing academic performance, successful intelligence, and learning attitudes among VTE students. The minimal impact of cognitive style on learning outcomes suggests that the flipped classroom approach is broadly effective across different cognitive preferences.

The qualitative data support these quantitative results by highlighting the benefits of the flipped classroom in terms of student engagement, comprehension, and attitudes towards learning. This comprehensive understanding reinforces the effectiveness of flipped classroom strategies in VTE contexts and advocates for their wider adoption to improve learning outcomes and student experiences.

5. Discussion

This study provides insights into the effectiveness of flipped classroom approaches in enhancing learning outcomes among first-year management students in vocational colleges in Anhui Province, China. By analyzing both quantitative data on academic achievement and attitudes towards learning, and qualitative insights from student experiences and instructor observations, the study offers a comprehensive understanding of the impact of instructional methodologies on student learning experiences and outcomes.

5.1 Academic Achievement

5.1.1 H1o and H1a: Traditional Classroom Instruction

Hypotheses H1o and H1a focus on the mean difference in academic test scores before and after traditional classroom instruction. The observed increase in academic test scores, with a mean gain of 3.4 points, indicates that traditional classroom instruction has a positive effect on students' academic performance. This finding aligns with existing literature, which underscores the efficacy of traditional teaching methods in structured, content-driven educational environments (Santos & Serpa, 2020). Traditional instruction offers a consistent framework conducive to measurable academic improvements, such as test scores (Nugraheni, Surjono, & Aji, 2022).

However, the 3.4-point increase, while significant, raises questions about the broader implications of traditional teaching methods. Although beneficial, traditional instruction may not fully address the diverse learning needs of all students. Comparative studies show mixed outcomes when contrasting traditional instruction with innovative methods like flipped classrooms or blended learning. Traditional models may not adequately foster critical thinking, creativity, and practical application of knowledge—skills increasingly valued in modern education and the workforce (Zheng & Wang, 2022). There is a growing recognition of the need for more student-centered and interactive teaching practices to meet the evolving demands of the global workforce (Shi et al., 2020). A more holistic approach, integrating traditional methods with active learning, technology-enhanced instruction, and experiential learning, would better prepare students for modern careers (Chen, 2023; Khodaei, Hasanvand, Gholami, Mokhayeri, & Amini, 2022).

5.1.2 H4o and H4a: Flipped Classroom Instruction

Hypotheses H4o and H4a address the impact of flipped classroom instruction on academic achievement. H4o posits no significant difference in academic test scores before and after flipped classroom instruction, while H4a asserts a significant difference exists. Our study provides compelling evidence supporting H4a, showing a significant mean increase of 7.8 points in academic test scores for students who experienced flipped classroom instruction. This substantial gain underscores the flipped classroom model's effectiveness in fostering a deeper understanding and retention of course material.

The flipped classroom model promotes active learning, enhancing comprehension and long-term retention of knowledge as students engage more deeply with the material (Doğan, Batdı, & Yaşar, 2023; Jdaitawi, 2020; Jeong, González-Gómez, & Cañada-Cañada, 2021). It also facilitates a personalized learning experience, allowing students to learn at their own pace outside of class and engage in collaborative activities during class, which encourages peer-to-peer learning (Zheng & Wang, 2022; Shi et al., 2020). This approach better prepares students

for the workforce by engaging them in real-world problem-solving and collaborative projects, developing essential soft skills (Yang, Chen, Akçapınar, Flanagan, & Ogata, 2021). Additionally, the flipped classroom model enhances student motivation and engagement, leading to improved academic performance (Ismaniati, Muhtadi, Cobena, & Soeparno, 2023).

5.2 Successful Intelligence

5.2.1 H2o and H2a: Traditional Classroom Instruction

Hypotheses H2o and H2a focus on the impact of traditional classroom instruction on successful intelligence, which includes analytical, creative, and practical intelligence. H2o posits no significant change in successful intelligence scores before and after traditional classroom instruction, while H2a asserts that such a change does exist. Our study revealed a negligible change in successful intelligence scores, supporting H2o and suggesting that traditional methods may not significantly enhance these broader cognitive abilities.

Traditional classrooms often rely on lectures and rote learning, limiting opportunities for deep analytical thinking and creativity (Eghtesadi Roudi, 2020). The structured and rigid format of traditional classrooms may stifle creativity by constraining students to specific answers and methods (Huang, Lu, & Yang, 2023). Additionally, traditional instruction tends to separate theoretical learning from practical application, which can hinder students' ability to translate knowledge into practical solutions (Plucker, 2022).

5.2.2 H5o and H5a: Flipped Classroom Instruction

Hypotheses H5o and H5a examine the effect of flipped classroom instruction on successful intelligence. H5o posits no significant improvement in successful intelligence scores before and after flipped classroom instruction, while H5a asserts that such improvement does occur. Our findings robustly support H5a, demonstrating a significant enhancement in successful intelligence scores following flipped classroom instruction.

The flipped classroom model is effective in fostering analytical intelligence through active learning and social interaction (Saw & Han, 2021). It also enhances creative intelligence by encouraging experimentation and innovation in a dynamic and flexible learning environment (Cho et al., 2021; Huang et al., 2023). The model aligns with constructivist learning theories, emphasizing active engagement and social interaction in cognitive development (Ismaniati, Muhtadi, Cobena, & Soeparno, 2023). This approach provides ample opportunities for hands-on learning experiences and collaborative learning, which is crucial for developing successful intelligence.

5.3 Learning Attitude

5.3.1 H3o and H3a: Traditional Classroom Instruction

Hypotheses H3o and H3a focus on the impact of traditional classroom instruction on learning attitudes. H3o posits no significant change in learning attitude scores before and after traditional classroom instruction, while H3a asserts that such a change does occur. The findings indicate minimal change in learning attitude scores, supporting H3o and suggesting that traditional methods may not significantly alter students' attitudes towards learning.

In traditional settings, the teacher is the primary authority, and students are passive recipients of knowledge, which can diminish autonomy and intrinsic motivation (Cho et al., 2021). This dynamic may lead to a fixed mindset and negative learning attitudes, as students are less likely to view challenges as opportunities for growth (Li & Pilz, 2023). Additionally, traditional classrooms may not adequately address diverse learning needs, leading to disengagement and negative attitudes towards learning (Yılmaz & Yılmaz, 2023).

5.3.2 H6o and H6a: Flipped Classroom Instruction

Hypotheses H6o and H6a address the impact of flipped classroom instruction on learning attitudes. H6o posits no significant change in learning attitude scores before and after flipped classroom instruction, while H6a asserts that such a change does exist. Our study robustly supports H6a, indicating a significant enhancement in learning attitude scores following flipped classroom instruction.

In a flipped classroom, the teacher's role shifts to a facilitator, empowering students to take greater ownership of their learning, leading to increased motivation and engagement (Capone, 2022; Nguyen et al., 2021; Nguyen et al., 2021; Yu, Gao, & Wang, 2021). Active learning keeps students engaged, fostering a sense of community and belonging, which significantly enhances learning attitudes (Cho et al., 2021). The flipped classroom also promotes a growth mindset, encouraging students to view challenges as opportunities for growth.

5.4 Moderating Role of Cognitive Style

5.4.1 H7o and H7a: Traditional Classroom Instruction

Hypotheses H7o and H7a investigate whether cognitive style moderates the relationship between demographic

profiles (such as college and gender) and learning performance in traditional classroom instruction. H7o posits no significant moderation effect, while H7a suggests such an effect exists. Our findings support H7o, indicating a non-significant moderation effect of cognitive style on this relationship in traditional classroom settings.

Traditional classrooms often employ uniform instructional methods that do not cater to individual cognitive styles (Setiawan et al., 2020; Sheromova et al., 2020). This lack of differentiation may neutralize the moderating effects of cognitive style on learning performance across different demographic groups, leading to non-significant moderation effects (Chuang, 2021).

5.4.2 H8o and H8a: Flipped Classroom Instruction

Hypotheses H8o and H8a examine the moderating effect of cognitive style on the relationship between demographic profiles and learning performance in flipped classroom instruction. H8o posits no significant moderation effect, while H8a suggests such an effect exists. Our findings support H8o, indicating a non-significant moderation effect of cognitive style.

The flipped classroom's variety of activities and personalized approach ensures that different cognitive styles are accommodated and engaged, reducing the potential for any single style to dominate the learning process (Sweller, 2020). This approach helps students develop a richer understanding of the material (Mayer, 2021), with targeted support and feedback addressing diverse cognitive needs (Steichen & Fu, 2020).

6. Conclusion and Recommendations

The study demonstrates that flipped classroom approaches significantly improve academic achievement and learning attitudes compared to traditional methods. Students value active participation and application-oriented learning, while instructors note increased engagement and critical thinking. Challenges include managing class time and supporting self-directed learning. To enhance the effectiveness of flipped classrooms in vocational education, policy recommendations include developing curriculum standards, aligning with national policies, and investing in educator training. Additionally, addressing equity and accessibility, fostering collaboration, and ensuring alignment with industry needs are crucial for optimizing flipped classroom approaches. These steps will support the successful adoption and implementation of flipped classrooms, enhancing vocational education outcomes in Anhui Province, China.

Acknowledgments

I am deeply grateful for the financial support provided by the Department of Education of Anhui Province, which has made this study possible.

My heartfelt thanks go to Dr. Siti Mariam Binti Abdullah for her invaluable guidance, inspiration, and unwavering support throughout this research. Her insightful feedback and commitment to academic excellence have profoundly influenced my intellectual journey.

I also wish to extend my sincere appreciation to Professor Dr. Puah Chin Hong for his rigorous approach and meticulous attention to detail, which have significantly shaped my development as a researcher. His scholarly rigor and positive outlook have been a constant source of motivation.

Both Dr. Siti Mariam and Professor Dr. Puah Chin Hong have been exceptionally supportive throughout the challenging process of writing this thesis. Their mentorship and genuine concern for my academic progress have been indispensable.

Authors' contributions

Dr. Wanmei Wang was responsible for the study design, data collection, analysis, and drafting of the manuscript. Dr. Siti Mariam Abdullah provided supervision and critical revisions to the study design and manuscript. Professor Dr. Chin-Hong Puah contributed to the statistical analysis and interpretation of data, as well as the preparation of the theoretical framework. All authors read and approved the final manuscript. There were no special agreements concerning authorship, and the contributions were aligned with the roles outlined above.

Funding

This research was funded by the Department of Education of Anhui Province, grant number 2022AH052175.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Canadian Center of Science and Education.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

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

Data sharing statement

No additional data are available.

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Appendix A

Summary Results Of Hypothesis Testing

Hypotheses	Results	Conclusion
H1o: The mean difference in academic test scores before and after based on traditional classroom model is zero in the population. H1a: The mean difference in academic test scores before and after based on traditional classroom model is not equal to zero.	Pre-*m*=30.68, *sd*=4.080 Post-*m*=61.67, *sd*=5.352 *t*=-116.33 *p*=.000	H1o is rejected in favour of H1a. There is a significant difference in academic test scores before and after in a traditional classroom.
H2o: The mean difference in successful intelligence scores before and after based on the traditional classroom model is zero in the population. H2a: The mean difference in successful intelligence scores before and after based on the traditional classroom model is not equal to zero.	Pre-*m*=19.88, *sd*=2.029 Post-*m*=19.81, *sd*=1.968 *t*=.640 *p*=.523	H2a is rejected in favour of H2o. There is a significant difference in successful intelligence before and after in a traditional classroom.
H3o: The mean difference in learning attitude test scores before and after based on the traditional classroom model is zero in the population. H3a: The mean difference in learning attitude test scores before and after based on the traditional classroom model is not equal to zero in the population.	Pre-*m*=69.03, *sd*=6.415 Post-*m*=68.64, *sd*=6.491 *t*=1.097 *p*=.273	H3a is rejected in favour of H3o. There is a significant difference in learning attitude before and after in a traditional classroom.
H4o: The mean difference in academic test scores before and after the flipped classroom model is zero in the population. H4a: The mean difference in academic test scores before and after the flipped classroom model is not equal to zero in the population.	Pre-*m*=30.82, *sd*=4.083 Post-*m*=72.47, *sd*=5.507 *t*=-161.866 *p*=.000	H4o is rejected in favour of H4a. There is a significant difference in academic test scores before and after in a flipped classroom.
H5o: The mean difference in successful intelligence scores before and after based on the flipped classroom model is zero in the population. H5a: The mean difference in successful intelligence scores before and after based on the flipped classroom model is not equal to zero in the population.	Pre-*m*=19.84, *sd*=2.000 Post-*m*=28.98, *sd*=2.215 *t*=-86.054 *p*=.000	H5o is rejected in favour of H5a. There is a significant difference in successful intelligence before and after in a flipped classroom.
H6o: The mean difference in learning attitude test scores before and after based on the flipped classroom model is zero in the population. H6a: The mean difference in learning attitude test scores before and after based on the flipped classroom model is not equal to zero in the population.	Pre-*m*=68.95, *sd*=6.490 Post-*m*=102.04, *sd*=6.855 *t*=-83.123 *p*=.000	H6o is rejected in favour of H6a. There is a significant difference in learning attitude before and after in a flipped classroom.

The flipped classroom model significantly improve academic achievement compared with the traditional classroom model. The flipped classroom model do not significantly improve academic achievement compared with the traditional classroom model.	Control Group: Pre-*m*=30.68, *sd*=4.080 Post-*m*=61.67, *sd*=5.352 Experimental Group: Pre-*m*=30.82, *sd*=4.083 Post-*m*=72.47, *sd*=5.507 Pre-*t*=-.573, *p*=.567 Post-*t*=-31.422, *p*=.000	The flipped classroom model significantly improve academic achievement compared with the traditional classroom model.
The flipped classroom model significantly improve successful intelligence compared with the traditional classroom model. The flipped classroom model do not significantly improve successful intelligence compared with the traditional classroom model.	Control Group: Pre-*m*=19.88, *sd*=2.029 Post-*m*=19.81, *sd*=1.968 Experimental Group: Pre-*m*=19.84, *sd*=2.000 Post-*m*=28.98, *sd*=2.215 Pre-*t*=.345, *p*=.730 Post-*t*=-69.233, *p*=.000	The flipped classroom model significantly improve successful intelligence compared with the traditional classroom model.
The flipped classroom model significantly improve learning attitude compared with the traditional classroom model. The flipped classroom model do not significantly improve learning attitude compared with the traditional classroom model.	Control Group: Pre-*m*=69.03, *sd*=6.415 Post-*m*=68.64, *sd*=6.491 Experimental Group: Pre-*m*=68.95, *sd*=6.490 Post-*m*=102.04, *sd*=6.855 Pre-*t*=.211, *p*=.833 Post-*t*=-79.113, *p*=.000	The flipped classroom model significantly improve learning attitude compared with the traditional classroom model.
H7o:Cognitive Style does not moderate the relationship between selected demographic profile (College, Gender) and Learning Performance for traditional classroom model. H7a:Cognitive Style moderates the relationship between selected demographic profile (College, Gender) and Learning Performance for traditional classroom model.	$R^{2=}$.229 *F*=20.85 *p*=.000 *Y*=College B (4.71) + College M (2.92) + College W (-1.11) + College E (-1.59) Cognitive p=0.75, >.05 (moderator)	H7a is rejected in favour of H7o. Cognitive style does not moderate the relationship between demographic profile and learning performance in a traditional classroom.
H8o: Cognitive Style does not moderate the relationship between selected demographic profile (College, Gender) and Learning Performance for flipped classroom instruction. H8a:Cognitive Style moderates the relationship between selected demographic profile (College, Gender) and Learning Performance for flipped classroom instruction.	$R^{2=}$.289 *F*=28.54 *p*=.000 *Y*=College M (3.27) + College B (2.96) + College E (-2.17) + College W (-3.00) Cognitive *p*=0.78, >.05 (moderator)	H8a is rejected in favour of H8o. Cognitive style does not moderate the relationship between demographic profile and learning performance in a flipped classroom.