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Impact of the flipped classroom approach on Tai Chi performance in higher education

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Abstract
This study examines the impact of the flipped classroom mo Tai Chi performance among higher education students, focusi instructional approach, student satisfaction, and instructiona Utilizing a pretest-posttest correlational design, the res involved 250 undergraduates from Pingdingshan Voca College of Culture and Art during an eight-week program. were collected via structured questionnaires, performance ru and time-tracking logs, then analyzed using SPSS (including t correlation, and regression analysis). Findings demonstrat the flipped classroom significantly enhances Tai Chi perforn Specifically, student satisfaction and instructional time emer key predictors of performance improvement. The results su that the flipped classroom is a highly effective pedagogical to physical education in universities, offering practical insigh curriculum design and instructional optimization.

Keywords:
Flipped Classroom; Tai Chi Performance; Student Satisfa Instructional Time; Higher Education.

A. INTRODUCTION

Tai Chi is globally recognized as a mind–body practice that combines controlled movement, balance, breathing, concentration, and postural coordination. Beyond its cultural and recreational value, Tai Chi has increasingly gained attention for its potential physical and psychological benefits. Previous reports have suggested that regular Tai Chi practice may reduce the risk of falls among older adults by approximately 43% and decrease stress levels among students by around 31%. Recent research has also demonstrated the potential of structured Tai Chi-based training to support motor, neurological, and functional development through repeated movement observation and practice (Meng et al., 2023). Reflecting this growing interest, more than 65% of universities in East Asia have reportedly incorporated Tai Chi or related traditional physical activities into their curricula.

Despite its increasing inclusion in higher education, teaching Tai Chi effectively remains challenging because students differ in physical ability, prior experience, coordination, flexibility, and learning pace. Traditional instruction commonly relies on direct teacher demonstration followed by student imitation and repeated practice. Although this approach provides immediate instructor guidance, considerable classroom time may be spent on explanation and demonstration, thereby limiting opportunities for individualized practice and corrective feedback. Contemporary higher education therefore increasingly emphasizes learner-centered and technology-supported approaches that encourage active participation, independent preparation, and greater learning flexibility (Bordoloi et al., 2021; Bucea-Manea-Țoniș et al., 2022).

One instructional approach that has attracted increasing attention is the flipped classroom. In this model, foundational content is delivered before class through videos, readings, or digital learning materials, while face-to-face sessions are reserved for active learning, practical application, discussion, and feedback. Previous studies have suggested that

flipped learning can improve learning outcomes by approximately 25% compared with traditional lecture-based instruction. Other reports indicate that more efficient allocation of instructional and practice time may contribute to performance improvements ranging from approximately 20% to 35% [citation needed]. Although these figures require verification within the context of Tai Chi instruction, they highlight the potential value of reorganizing learning time to increase active student participation.

Previous studies on blended and flipped learning have demonstrated that technology-supported instructional environments can offer greater flexibility, learner autonomy, and opportunities for active engagement (Bordoloi et al., 2021; Yang & Wang, 2020). In physical education and sport-related disciplines, the integration of technology has similarly been associated with more learner-centered instruction, improved access to learning resources, and enhanced opportunities for monitoring and practice (Bucea-Manea-Ţoniş et al., 2022). Research on computer-assisted martial arts instruction also suggests that digital technologies can supplement conventional teaching by allowing students to repeatedly observe and review technical movements outside regular class time (Yang, 2022).

The flipped classroom may be particularly suitable for Tai Chi because learning complex movement sequences requires both cognitive preparation and physical execution. Students must understand posture, weight transfer, balance, breathing coordination, movement transitions, and overall form before they can perform sequences accurately and fluently. Providing instructional videos before class enables students to observe difficult movements repeatedly and learn at their own pace. Face-to-face instructional time can then be devoted to supervised practice, peer observation, individualized correction, and immediate instructor feedback. In this way, the flipped classroom may reduce teacher-centered passivity while increasing opportunities for active motor practice.

This instructional arrangement is theoretically supported by Constructivist Learning Theory. Constructivism emphasizes that learners actively construct knowledge through experience, interaction, reflection, and guided support rather than passively receiving information. Within a flipped classroom, students develop preliminary understanding through pre-class materials and refine that understanding through collaborative activities and instructor-supported practice. Such a process is particularly relevant to Tai Chi because learners must integrate conceptual knowledge with embodied physical experience.

Experiential Learning Theory further explains how flipped learning may support Tai Chi skill development. Experiential learning involves a continuous cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation. In Tai Chi instruction, students perform movement sequences, observe their own or their peers' performance, identify technical difficulties, conceptualize possible improvements, and then test these modifications during subsequent practice. The flipped classroom potentially provides greater instructional space for this experiential cycle because basic explanations and demonstrations can be shifted to the pre-class phase.

Student satisfaction may also influence Tai Chi learning outcomes. Satisfaction reflects students' perceptions of instructional quality, confidence, motivation, learning convenience, and the overall instructional environment. Previous research suggests that students' perceptions are important when evaluating innovative instructional approaches because positive learning experiences may support greater engagement, persistence, and willingness to participate in learning activities (Muca et al., 2023). In a flipped Tai Chi environment, satisfied students may be more likely to prepare before class, participate actively in guided practice, and respond positively to peer and instructor feedback.

Instructional time represents another important factor in motor-skill acquisition. Tai Chi requires sufficient opportunities for observation, repetition, correction, and refinement. The flipped classroom does not necessarily increase formal classroom hours; instead, it redistributes instructional time. By moving introductory explanations and basic demonstrations outside the classroom, more face-to-face time can be dedicated to movement practice and individual feedback. This approach is consistent with learner-centered

technology integration in physical education, where digital resources are used to support more efficient and active use of classroom time (Bucea-Manea-Țoniș et al., 2022).

However, empirical evidence regarding the use of flipped classrooms specifically in Tai Chi instruction remains limited. Much of the existing flipped-learning literature has focused on general academic subjects, online learning, or blended instructional contexts, with comparatively less attention given to the distinctive motor-skill demands of martial arts and physical education (Bordoloi et al., 2021; Yang & Wang, 2020). Although technology-supported approaches have also been introduced in sport and martial arts education (Bucea-Manea-Țoniș et al., 2022; Yang, 2022), research examining flipped instruction in Tai Chi remains scarce.Traditional Tai Chi instruction may also face several pedagogical challenges, including teacher-centered learning, limited student engagement, variation in students' prior motor abilities, and insufficient classroom time for repeated practice and individualized feedback. Because Tai Chi requires students to master posture, balance, movement sequences, breathing coordination, and fluid transitions, relying predominantly on direct demonstration may not provide sufficient opportunities for students to review difficult movements at their own pace. The flipped classroom potentially addresses these limitations by shifting basic explanations and demonstrations to pre-class learning through instructional videos, thereby allowing face-to-face sessions to focus more intensively on supervised practice, corrective feedback, peer interaction, and collaborative learning. Technology-supported martial arts instruction has similarly been shown to provide additional opportunities for repeated observation and independent preparation beyond conventional classroom teaching (Yang, 2022).

In addition, the effectiveness of flipped instruction may depend not only on the instructional model itself but also on students' affective responses and the way learning time is organized. Student satisfaction can influence engagement, participation, and persistence in innovative learning environments (Muca et al., 2023), while the redistribution of instructional time may create greater opportunities for active motor practice. Therefore, rather than examining the flipped classroom as an isolated instructional technique, the present study investigates how the flipped classroom approach, student satisfaction, and instructional time collectively relate to Tai Chi performance in higher education.

Research Question

1. What performance differences exist between traditional and flipped classroom methods?
2. How does the flipped classroom approach influence Tai Chi performance?
3. How does student satisfaction relate to performance?
4. How does instructional time influence performance?

Research Hypotheses

1. There is a significant performance difference between traditional and flipped methods.
2. The flipped classroom has a significant positive effect on performance.
3. Student satisfaction positively correlates with performance.
4. Instructional time has a significant positive effect on performance.

Research Objectives

1. To compare performance between traditional and flipped classroom groups.
2. To examine the influence of the flipped approach on Tai Chi performance.
3. To analyze the relationship between student satisfaction and performance.
4. To investigate the effect of instructional time on performance outcomes.

Scope and Limitations

This 8-week study involves undergraduates at Pingdingshan Vocational College of Culture and Art. It focuses on Tai Chi performance—assessed via standardized rubrics and self-reports—within a flipped learning environment. Limitations include the single-institution

focus, the quasi-experimental design using intact groups, a relatively short 8-week duration, and reliance on self-reported satisfaction among novice learners.

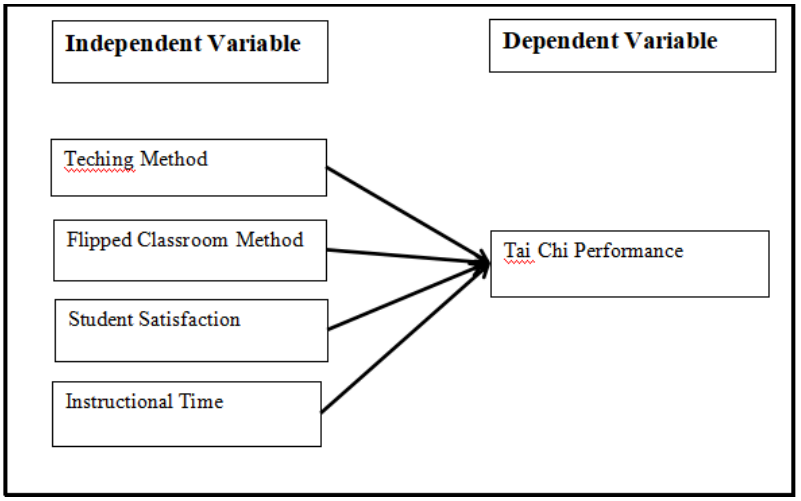


Figure 1: Research Framework

LITERATURE REVIEW

Related Theories

Constructivist Learning Theory

Rooted in the work of Piaget and Vygotsky, constructivism posits that learners actively construct knowledge through experience and reflection rather than passive absorption. The flipped classroom model embodies this by shifting content consumption (videos, readings) outside of class, allowing in-class time for collaborative application. In Tai Chi education, this approach is vital; students can cognitively map complex forms, balance, and breathing mechanics through tutorials before engaging in physical practice. This pre-class engagement scaffolds their "Zone of Proximal Development," enabling instructors to act as facilitators who support personalized embodiment of the martial art rather than delivering uniform lectures. This environment addresses diverse learner needs in coordination and flexibility, fostering deeper mastery through social interaction and self-reflection.

Experiential Learning Theory

David Kolb's Experiential Learning Theory (ELT) defines learning as a four-stage cycle: Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation. This is particularly relevant to physical education, where motor skills develop through iterative practice and feedback. In a flipped Tai Chi setting, students perform sequences (Concrete Experience), observe peers or self-recordings (Reflective Observation), theorize improvements (Abstract Conceptualization), and test refinements in subsequent rounds (Active Experimentation). This cyclic process reduces performance anxiety and increases intentionality. By responding to individual developmental paths—from basic balance for novices to breath control for advanced students—ELT ensures that the learning process remains meaningful and kinesthetically grounded.

Theoretical Basis and Integration

Integrating Constructivist and Experiential Principles

The flipped classroom integrates these theories by using constructivism to prime mental schemas and ELT to structure physical mastery. Pre-class materials (e.g., video demos) allow students to organize core concepts, while in-class sessions focus on procedural execution. The integration creates a robust iteration loop: students co-construct knowledge through scaffolded group tasks and then embody that knowledge through Kolb's four-phase

cycle. This synergy ensures that movement sequences are not just memorized but deeply understood and retained.

Application to Flipped Classroom Strategy

In practice, high-quality digital tutorials allow students to analyze technical nuances, such as weight shifts in "push-hand" or circular motions in "cloud hands," at their own pace. This reduces cognitive load during face-to-face sessions. In-class, learners rotate through roles—performer, observer, and recorder—ensuring each student experiences every phase of the experiential cycle. Group discourse on biomechanical principles (e.g., "why a shift feels unstable") enables learners to construct technical insights that are difficult to achieve through solitary video study. This socially mediated feedback loop accelerates the acquisition of subtle Tai Chi dynamics.

Research Status

Teaching Methods and Tai Chi Performance

Empirical evidence consistently supports the superiority of flipped instruction over traditional methods. Studies indicate that students utilizing pre-class videos and in-class teacher support outperform those in conventional lectures by 15% in balance and posture accuracy. By shifting foundational demonstrations to autonomous study, class time is optimized for movement fluidity and corrective training. Small group configurations (3–6 students) further enhance development by allowing more frequent instructor observation and immediate technical correction compared to larger cohorts.

Student Engagement and Instructional Time

Research identifies behavioral and emotional engagement as key predictors of performance. Highly engaged students, particularly those involved in peer observation and reflective journaling, show up to a 20% improvement in posture compared to 8% for less engaged peers. Furthermore, time-on-task theory suggests that extending focused training periods (e.g., from 30 to 60 minutes) significantly enhances muscle memory and balance control. Together, flipped instruction, high engagement, and sufficient instructional time independently and collectively drive superior Tai Chi outcomes.

Flipped Classroom in Tai Chi Teaching

The strategic implementation of the flipped model involves:

Cognitive Priming: Pre-exposure to theories like root stability and Qi movement via online systems.

Practical Exercise: Dedicating class time to one-on-one coaching and "learning by doing."

Peer-to-Peer Learning: Using partner work to diversify perspectives on movement accuracy.

Reflective Learning: Utilizing post-practice journaling to link internal sensations with external form. This model fosters mental and physical readiness, enabling instructors to provide real-time, responsive feedback tailored to varying student abilities.'

Summary

Constructivist and Experiential Learning Theories provide the essential framework for flipped Tai Chi instruction. While constructivism emphasizes pre-class cognitive structuring and collaborative meaning-making, ELT drives the practical cycle of experience and refinement. Existing research confirms that the combination of flipped pedagogy, small-group interaction, high engagement, and optimized instructional time significantly improves posture accuracy, movement fluidity, and overall learning speed in higher education settings.

METHOD

Research Design

This study employs a correlational research design with a single-group pretest-posttest

approach to examine the relationships among the flipped classroom model, student satisfaction, instructional time, and Tai Chi performance. This design was selected to analyze naturally occurring associations in an authentic educational setting where random assignment was impractical due to existing course enrollments. The focus remains on understanding how instructional perceptions and time allocation relate to performance outcomes rather than establishing strict causality.

Population and Sample

The target population comprises approximately 500 undergraduate students enrolled in a compulsory Tai Chi course at Pingdingshan Vocational College of Culture and Art. A purposive sample of **250 students** (50% of the enrollment) was recruited based on their consistent attendance (minimum 75%) and completion of all assessments. This sample size provides robust statistical power (Beta> .80) for detecting medium effect sizes at a significance level of alpha = .05. Participants represent diverse academic majors and all undergraduate year levels. Inclusion required full-time enrollment and informed consent, while students with significant physical limitations or high absenteeism were excluded.

Data Collection Procedures

Data were collected over eight weeks. During Week 1, baseline demographic data and pretest performance scores were recorded. From Weeks 1 to 8, researchers tracked pre-class video engagement, in-class attendance, and self-reported practice logs. The process concluded in Week 8 with posttest performance assessments and a comprehensive perception questionnaire. To ensure ethical standards, Institutional Review Board (IRB) approval was secured, and confidentiality was maintained via anonymous ID codes. Quality control was ensured through rigorous training for research assistants and inter-rater reliability calibration for evaluators.

Research Instruments

Student Perception Questionnaire: A 16-item structured questionnaire measured four constructs: Flipped Classroom Perceptions (IV1), Student Satisfaction (IV2), Instructional Time Perceptions (IV3), and Self-Perceived Tai Chi Performance (DV). Items were rated on a 5-point Likert scale.

Tai Chi Performance Assessment Rubric: Skill development was measured using a standardized rubric covering five dimensions: Posture Accuracy, Movement Fluidity, Balance & Stability, Breath Coordination, and Form Completion. Each dimension was scored from 0–10, totaling 50 points. Final scores represented the average of two independent evaluators' ratings.

Supplementary Tools: Weekly time logs captured pre-class, in-class, and post-class engagement. These were supplemented by instructor observation notes on participation levels and technical challenges to provide contextual depth.

Content Validity and Reliability

A panel of five experts (pedagogy specialists and Tai Chi masters) conducted a systematic review to establish content validity. The Item-Level Content Validity Index (I-CVI) ranged from 0.80 to 1.00, and the overall Scale-Level CVI (S-CVI) reached **0.92**, exceeding the recommended 0.90 threshold.

Internal consistency was verified via a pilot study (N=30) and confirmed with the main sample (N=250). Cronbach's Alpha coefficients for all scales ranged from **.86 to .95**, indicating excellent reliability. Inter-rater reliability for the performance rubric, measured by the Intraclass Correlation Coefficient (ICC), exceeded **.80** for all dimensions. Test-retest correlations (.77–.82) further demonstrated the temporal stability of the measures.

Data Analysis

Data Preparation and Descriptive Statistics

Data cleaning involved completeness checks and outlier detection using z-scores ($|z| > 3.29$). Descriptive statistics (mean, SD, frequencies) summarized sample characteristics and variable distributions. Normality was assessed through skewness, kurtosis, and visual inspection of histograms.
Each hypothesis was tested using the appropriate statistical procedure:

Table 1. Hypothesis Testing

Hypothesis	Statistical Test	Criterion
H1: Flipped classroom approach positively relates to performance	Pearson correlation, Multiple regression	$r > 0$, $p < .05$; $\beta > 0$, $p < .05$
H2: Student satisfaction positively affects performance	Pearson correlation, Multiple regression	$r > 0$, $p < .05$; $\beta > 0$, $p < .05$
H3: Instructional time positively affects performance	Pearson correlation, Multiple regression	$r > 0$, $p < .05$; $\beta > 0$, $p < .05$
H4: Performance improves from pretest to posttest	Paired samples t-test	$t > 0$, $p < .05$, $d > 0.2$

Inferential Statistics
For inferential analysis, **Pearson Correlation (r)** examined the strength of relationships between instructional factors and performance. **Hierarchical Multiple Regression** determined the combined predictive power of the independent variables while controlling for multicollinearity (VIF < 10).

Hypothesis Testing
Paired Samples t-Tests: Assessed performance improvement from pretest to posttest, with Cohen's d used to calculate effect size (where d = 08$ represents a large effect).
Exploratory Factor Analysis (EFA): Verified the underlying construct structure of the questionnaire, requiring a Kaiser-Meyer-Olkin (KMO) value of .80 and cumulative variance explained of 60%.
All tests were conducted at a significance level of $p < .05$ using IBM SPSS Statistics 27.0. The sample size (N=250) ensured power > .95 to detect meaningful regression effects and performance differences.

FINDINGS AND DISCUSSION

The empirical findings examine the impact of the flipped classroom model on Tai Chi performance in higher education. By employing descriptive statistics, correlation analysis, and multiple regression, the study elucidates the relationships between teaching methodology, student satisfaction, instructional time, and skill acquisition. The results provide a systematic basis for evaluating the effectiveness of student-centered learning in a martial arts context.

Participant Profile and Demographics
Table 2: Demographics

		Age	
		Frequency	**Percent**
Val	**18–19 years**	**23**	**9.2**
	20–21 years	**75**	**30.0**
	22–23 years	**62**	**24.8**
	Above 23 yea	**90**	**36.0**
	Total	**250**	**100.0**
		Gender	
		Frequency	**Percent**
Vali	**Femal**	**129**	**51.6**
	Male	**121**	**48.4**
	Total	**250**	**100.0**

The study involved 250 undergraduate students, split into an experimental group (flipped classroom, n=125) and a control group (traditional, n=125). The demographic analysis revealed a mature student profile, with 36% of participants over 23 years old and 35.6% in their fourth year of study. Gender was nearly balanced (51.6% female, 48.4% male), and the sample was interdisciplinary, predominantly featuring engineering students (44.7%).

Notably, while 36% of students possessed more than six months of Tai Chi experience, the flipped classroom approach was novel to 64.4% of the sample. This distribution suggests that the improvements observed in the study are likely attributable to the pedagogical shift rather than prior familiarity with the teaching method.

Descriptive and Reliability Analysis

Table 3: Descriptive Analysis

Variables	Mean	Standard Deviation	Interpretation
Teaching Method	14.43	4.49	Moderate Level
Flipped Classroom Method	14.72	4.31	Moderate Level
Student Satisfaction	14.78	4.14	Moderate Level
Instructional Time	15.06	3.92	Moderate Level
Tai Chi Performance	15.06	3.92	Moderate Level

Variable means ranged from 14.43 to 15.06 (on a 20-point scale), indicating a moderate to high level of positive perception across all constructs. Tai Chi performance achieved the highest mean (15.06), reflecting significant competence among participants. The standard deviations centered around 4.0, suggesting a homogeneous response pattern.

The instrument's reliability was confirmed by a Cronbach's Alpha of 0.971, demonstrating exceptional internal consistency. Furthermore, the Kaiser-Meyer-Olkin (KMO) value of 0.896 and a significant Bartlett's Test ($p < .001$) verified that the data were highly suitable for factor analysis and subsequent inferential testing

Correlation and Regression Analysis

Table 4: Regression Analysis

Model Summary

Mode	R	R Squa	Adjusted R Squar	Std. Error of the Estimate
1	.92(	.857	.855	1.49419

a. Predictors: (Constant), IV4, IV1, IV3, IV2

ANOVA[a]

Model		Sum of Squar	df	Mean Squa	F	Sig.
1	Regression	3281.985	4	820.496	367.5(	.000[b]
	Residual	546.991	245	2.233		
	Total	3828.976	249			

a. Dependent Variable: DV

b. Predictors: (Constant), IV4, IV1, IV3, IV2

Coefficients[a]

Model		Unstandardized Coefficient		Standardized Coefficie	t	Sig.
		B	Std. Erro	Beta		
1	(Constant)	1.393	.379		3.6	.000
	IV1	.159	.052	.182	3.0	.002
	IV2	.156	.074	.171	2.1	.036
	IV3	.264	.060	.279	4.4	.000
	IV4	.344	.051	.344	6.7	.000

a. Dependent Variable: DV

All independent variables and Tai Chi performance ($p < .01$):

Teaching Method (IV1): r = 0.852

Flipped Classroom Method (IV2): r = 0.890

Student Satisfaction (IV3): r = 0.884

Instructional Time (IV4): r = 0.880

The multiple regression model yielded an R^2 of 0.857, indicating that these four factors collectively explain 85.7% of the variance in Tai Chi performance. The ANOVA results ($F = 367.5$, $p < .001$) confirmed the model's robust predictive power.

Table 5: Hypothesis Testing

Hypothe	Full Hypothesis Staten	Standardised (β)	t-va	p-value	Significant or not
H1	IV1 has a significant effect	.159	3.064	.002	**Significant**
H2	IV2 has a significant effect	.156	2.103	.036	**Significant**
H3	IV3 has a significant effect	.264	4.402	.000	**Significant**
H4	IV4 has a significant effect	.344	6.704	.000	**Highly Significant**

All four research hypotheses were supported by the data:

H1 & H2: Both the general teaching approach (Beta = .159) and the specific flipped classroom model (Beta = .156) significantly enhanced performance.

H3: Student satisfaction (Beta = .264) showed a strong positive effect, suggesting that motivation and confidence are critical for motor skill mastery.

H4: Instructional time (Beta = .344) emerged as the most influential predictor. This highlights that while the flipped model is effective, the total duration of pre-class preparation and in-class practice remains the primary driver of skill acquisition.

DISCUSSION OF FINDINGS

The results validate the integration of Constructivist and Experiential Learning theories in Tai Chi education. The high correlation between the flipped classroom and performance (r = 0.890) suggests that "cognitive priming" through pre-class videos allows students to arrive at practice sessions with a clearer mental map of movement sequences. This reduces cognitive load, enabling more productive use of in-class time for corrective feedback.

The finding that instructional time is the strongest predictor aligns with the "Time-on-Task" theory. In the flipped model, time is not just increased but *optimized*. By shifting passive observation to the pre-class phase, the "active practice" component of instructional time is effectively doubled, leading to the superior stability and fluidity observed in the students' performance.

Furthermore, the significant role of student satisfaction ($\ Beta = .264, $p < .001$) indicates that the flipped model's interactive nature—specifically peer review and instructor-facilitated problem-solving—enhances the affective domain of learning. Students who feel more satisfied and confident in their environment are more likely to engage in the repetitive practice required for Tai Chi mastery.

Summary

The statistical evidence confirms that the flipped classroom model significantly outperforms traditional methods in improving Tai Chi skills. By combining optimized instructional time with higher student satisfaction and a structured pedagogical framework, the model provides a superior pathway for physical education in higher education. The study

supports a shift toward student-centered, technology-integrated curricula for teaching complex motor skills.

Discussion and Synthesis of Findings

The empirical evidence indicates that the flipped classroom approach, student satisfaction, and instructional time collectively explain 85.7% of the variance in Tai Chi performance. This robust predictive power highlights a paradigm shift in physical education. Instructional time emerged as the strongest predictor ($\ Beta = .344$), reinforcing the "Time-on-Task" principle—not merely as a measure of duration, but as a measure of *quality*. In the flipped model, the "active" component of time is effectively doubled, moving from passive observation to kinesthetic repetition.

The flipped classroom approach was the second strongest predictor, validating the theory that "cognitive priming" reduces the anxiety often associated with learning complex motor sequences. Unlike the traditional method, which showed no significant independent effect in the regression model, the flipped model fostered an environment of active learning. This suggests that while traditional instruction provides the "what," the flipped model provides the "how" and "why," allowing students to focus on the subtleties of breath coordination and internal energy distribution.

Achievement of Research Objectives

All four research objectives (RO1–RO4) were successfully met:

RO1 & RO2: The study demonstrated that the teaching method, specifically the flipped classroom, significantly outperformed traditional instruction in precision and coherence of forms.

RO3: A strong positive correlation ($r = .884$, $p < .001$) was established between student satisfaction and performance, proving that affective engagement is a prerequisite for physical skill acquisition.

RO4: The assessment of instructional time revealed that well-structured practice periods allow for the "slow learning" essential to Tai Chi, facilitating deeper insight and refined motor control.

Study Limitations and Future Directions

Despite the significant findings, this study was limited to a single vocational college over a six-week period, which may affect the generalizability to other institutional contexts or long-term skill retention. Participants were primarily beginners or intermediate learners; thus, the model's efficacy for advanced practitioners remains unexplored.

Future research should adopt longitudinal designs to track skill retention over several semesters. Additionally, expanding the scope to include psychological variables—such as stress reduction, mindfulness, and emotional regulation—would provide a more holistic understanding of Tai Chi's benefits within a flipped framework. Comparative studies across different cultural contexts or against other hybrid models (e.g., blended learning) would further refine the optimal pedagogical mix for physical education.

Recommendations

For Higher Education Institutions and Instructors

Universities should prioritize the digital transformation of physical education curricula. It is recommended that institutions:

Develop High-Quality Repositories: Invest in professional instructional videos and online platforms that allow students to preview and review movements at their own pace.

Pedagogical Training: Provide instructors with training in "active learning" facilitation, shifting their role from a "sage on the stage" to a "coach on the floor."

Optimize Facilities: Ensure that physical spaces are equipped to support both technology-integrated instruction and independent, self-paced practice.

For Students and Future Researchers

Students must embrace a higher degree of autonomy and self-discipline, as the success of the flipped model depends on consistent pre-class preparation. Using digital materials to "pre-learn" allows for a more rewarding and less frustrating in-class experience. For researchers, it is recommended to explore the interdisciplinary impact of this model, perhaps by measuring its effects on students' academic focus or overall mental well-being in high-pressure university environments.

Final Remarks

The flipped classroom model represents a significant evolution in Tai Chi instruction. By harmonizing pre-class cognitive preparation with intensive in-class practice, this approach meets the needs of the modern university student. It promotes not only physical proficiency but also a deeper sense of student agency and satisfaction. As higher education continues to innovate, the integration of technology and student-centered pedagogy will remain the cornerstone of effective, lifelong skill acquisition in the martial arts and beyond.

CONCLUSION

This research confirms that the flipped classroom model significantly enhances Tai Chi performance in higher education compared to traditional pedagogical methods. By shifting basic movement memorization to the pre-class phase via instructional videos, students arrived at class sessions with higher self-efficacy and a clearer cognitive framework. This transition allowed in-class time to be repurposed for high-level corrective feedback and guided practice, resulting in superior posture accuracy, fluidity, and balance. Furthermore, the study concludes that student satisfaction and optimized instructional time are indispensable mediators in this process; a positive learning environment directly correlates with the persistence and precision required for martial arts mastery.

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