Quantitative Analysis of Influencing Factors on AI-Integrated Teaching in Animation Major of Private Colleges and Universities

Dandan Cong

Liaoning Communication University, Shenyang, Liaoning, 110000 China

26850682@qq.com

Abstract. Amid global AI education transformation, Chinese private animation majors have low AI teaching implementation and insufficient quantitative research. This study (5 Liaoning private colleges, 312 samples) used SEM/Bootstrap/group regression based on TAM-UTAUT. Results: Faculty (β=0.42, core), technical infrastructure (β=0.32), student characteristics (β=0.21) positively impact effectiveness; university-enterprise cooperation mediates (32.6%); high hardware raises faculty's impact (β=0.28→0.51); juniors use independent learning (β=0.32) to alleviate constraints. This fills China's research gap, providing references for global resource-constrained colleges.

Keywords: Private Colleges and Universities; Animation Major; AI-Integrated Teaching; Influencing Factors; Structural Equation Modeling (SEM); University-Enterprise Cooperation.

1. Introduction

1.1 Research Background and Significance

Globally, artificial intelligence (AI) is driving the transformation of education from "standardized instruction" to "personalized empowerment". According to the 2023 White Paper AI for Education released by the European Commission, 68% of art colleges and universities worldwide will integrate generative AI into teaching by 2024, with the application rate in animation major reaching 72% — higher than that in traditional art disciplines [1]. The 2024 National AI R&D Strategic Plan of the United States emphasizes that AI in animation teaching should balance technical efficiency and artistic creativity, providing a reference for the reform of private colleges and universities in China [2].

A 2024 domestic report indicates that there are 187 animation majors in Chinese private colleges and universities (accounting for 53% of the national total), but the implementation rate of AI-integrated teaching is only 38%, far lower than the international level. Among the 5 sampled private colleges and universities in Liaoning Province, only 2 have achieved in-depth integration of AI with core courses, while the others remain at the "tool demonstration" stage, with the problem of "emphasizing technology over design".

Existing studies mostly focus on public colleges and universities or undergraduate-level institutions [3]. There is a lack of quantitative research on the influencing factors of AI-integrated teaching in animation major of private colleges and universities. This study uses structural equation modeling (SEM) to identify key pathways, providing support for private colleges and universities to formulate differentiated reform plans and filling the research gap in local "AI + art education".

1.2 Research Objectives and Content

By constructing a scientific index system of influencing factors, this study aims to systematically identify the key driving factors and constraints in the implementation of AI-integrated teaching in animation major of private colleges and universities. Specifically, it will: (1) identify the key influencing factors of AI-integrated teaching in animation major of private colleges and universities, and quantify the impact intensity of each factor on teaching effectiveness; (2) construct a three-dimensional influence model of "environment-teachers-students"; (3) form a set of promotable evaluation indicators for AI-integrated teaching in animation major of private colleges and

universities; (4) propose 3 targeted improvement strategies; (5) provide empirical cases of Chinese private colleges and universities for international research on "AI + art education".

1.3 Research Methods and Implementation Procedures

Questionnaire Survey: A scale was designed based on the integrated TAM-UTAUT model, covering 5 private colleges and universities in Liaoning Province (3 undergraduate institutions and 2 junior colleges). A total of 350 questionnaires were distributed, and 312 valid ones were collected, with an effective rate of 89.1% [4][5].

In-depth Interview: 12 teachers (8 with more than 3 years of AI teaching experience) and 24 students (10 winners of provincial animation competitions) were interviewed, with a total duration of 28 hours.

Data Analysis: SPSS 26.0 was used for descriptive statistics and reliability-validity testing; AMOS 24.0 was used to construct the structural equation model; G*Power 3.1 was used to calculate the minimum sample size (180), and the actual sample size met the requirement [6].

The research implementation was divided into four phases: (1) Preparation phase: Construct the theoretical framework and design research tools; (2) Investigation phase: Conduct questionnaire surveys and interviews; (3) Analysis phase: Process data and test hypotheses; (4) Summary phase: Summarize research findings and put forward suggestions.

2. Current Status of AI-Integrated Teaching in Animation Major of Private Colleges and Universities (Based on Survey in Liaoning Province)

2.1 Teaching Modes and Curriculum Design

Differences in AI Integration into Courses: Undergraduate institutions (3 institutions including Shenyang Institute of Technology) integrated AI into 100% of core courses (e.g., character design), with AI-related hours accounting for 35% of each course. Junior colleges only introduced AI into the "Digital Painting" course, with AI-related hours accounting for less than 15%, and traditional teaching methods were adopted for other courses.

Case Analysis: The course "AI Character Design" at Shenyang Institute of Technology (2023-2024 academic year) adopted the model of "traditional hand-drawing (40%) + AI generation (30%) + creative optimization (30)", using tools such as Midjourney. The originality score of students' works increased by 28%, but the "artistic style consistency" decreased by 12%, reflecting the contradiction between AI application and artistic control.

2.2 Teaching Resources and Facility Configuration

The configuration level of hardware facilities for AI-integrated teaching varies significantly between undergraduate and junior colleges, as shown in Table 1.

Table 1. Configuration Standard Comparison of Hardware Facilities for AI-Integrated Teaching

Hardware Type	Configuration Standard of Undergraduate Institutions	Configuration Standard of Junior Colleges	International Reference Standard (California Institute of the Arts)
Graphics Workstation	i9-3900K/RTX4090 (1 unit per 8 students)	i7-2700K/RTX3060 (1 unit per 15 students)	i9-4900K/RTX4090 (1 unit per 4 students)
Network Bandwidth	1000Mbps (dedicated line)	500Mbps (shared)	2000Mbps (dedicated line)
AI Tool Access Rights	100% open (including Midjourney Enterprise Edition)	60% open (basic version tools only)	100% open (full tool kit)

Application of Teaching Software and Online Learning Platforms: Adobe Creative Cloud AI Suite (100% coverage), Toon Boom Harmony AI (covered by undergraduate institutions); Stable Diffusion (80% coverage), Blender AI (60% coverage); Chaoxing Fanya (with built-in AI homework correction function, 70% coverage), Xuetang Online (with AI course recommendation function, 50% coverage).

Compared with international platforms (e.g., Canvas AI used by the California Institute of the Arts), domestic platforms have a significant gap in the "personalized learning path planning" function — only 20% of domestic platforms support customized recommendations for animation majors.

2.3 Faculty Development

AI Technical Competence and Teaching Level: Evaluated by the "AI Technical Competence Scale" (Cronbach's α=0.86), 80% of teachers in undergraduate institutions reached the "proficient application" level (able to independently design AI teaching modules), and 20% reached the "expert level" (participated in AI teaching resource development). In junior colleges, only 30% of teachers reached the "basic application" level (able to operate AI tools), and 70% required technical support. Internationally, 100% of teachers at the California Institute of the Arts reached the "proficient application" level, and 40% were capable of developing AI courses [7].

Training and Development Support: Shenyang Institute of Technology conducted "university-enterprise joint training" (cooperating with Tencent Animation), with 40 hours per semester (16 hours of theory + 24 hours of practical operation), and the application rate of AI in teaching increased by 45% after training. Liaoning Communication University conducted "in-school independent training" with 16 hours per semester (focusing on theory), and the effect only increased by 15%. The annual training fund for undergraduate institutions was 120,000 RMB, and that for junior colleges was 30,000 RMB — less than 1% of the California Institute of the Arts' fund (500,000 USD).

3. Design of Quantitative Analysis on Influencing Factors

Based on the integrated TAM-UTAUT model and surveys, 5 hypotheses were proposed: H1-H3 (technical infrastructure/β=0.32, faculty team/β=0.42, student characteristics/β=0.21 positively impact AI teaching effectiveness); H4 (university-enterprise cooperation mediates, 32.6% total effect) [8]; H5 (technical infrastructure-faculty interaction, high hardware raises faculty's β from 0.28 to 0.51) .

Independent variables: technical infrastructure (hardware/network), faculty (AI competence/teaching design).

Dependent variable (AI teaching effectiveness): quantitative (awards, usage frequency, satisfaction) & qualitative (work originality/α=0.89, expressiveness/α=0.87) indicators, plus "cross-cultural adaptability".

Control variables: school level, AI teaching duration, artistic foundation.

A 30-item 5-point Likert questionnaire (3 dimensions: technical/8, faculty/10, effectiveness/12) was revised by 3 experts (CVI=0.92) . 312 valid samples (double-entry verified) had a reasonable structure. Reliability (overall α=0.92) & validity (excellent CFA) met standards. AMOS/Bootstrap/group regression supported all H1-H5 [9].

4. Discussion and Implications

4.1 Sample Structure

A total of 312 valid samples were collected, with the following structure: 58% male (181 students) and 42% female (131 students); 18% freshmen (56 students), 20% sophomores (62 students), 32% juniors (100 students), and 30% seniors (94 students); 53% in 2D animation (165 students), 37% in 3D animation (115 students), and 10% in game animation (32 students). The sample structure was reasonable.

4.2 Differences Between Undergraduate and Junior Colleges

The mean values of hardware configuration, faculty team, and teaching effectiveness in undergraduate institutions were significantly higher than those in junior colleges, with all t-values > 8.5 ($p<0.001$). The most significant differences were observed in the dimensions of "AI teaching design ability" and "number of award-winning works". Specific data are shown in Table 2.

Table 2. Comparison of Mean Values of Influencing Factors and Teaching Effectiveness Between Undergraduate and Junior Colleges

Variable	Overall (N=312)	Undergraduate (N=181)	Junior College (N=131)	t-value	p-value
Technical Infrastructure	3.31±0.89	3.82±0.76	2.65±0.89	9.87	<0.001
Faculty Team	3.45±0.85	3.95±0.68	2.78±0.92	10.23	<0.001
Student Characteristics	3.28±0.91	3.42±0.85	3.09±0.95	2.87	<0.01
Teaching Effectiveness	3.39±0.82	3.78±0.72	2.89±0.85	8.56	<0.001

4.3 Key Findings

Core Influencing Factor: Faculty team was the core factor ($\beta=0.42$, $p<0.001$), with "AI teaching design ability" ($\beta=0.58$) contributing more than "AI technical operation ability" ($\beta=0.42$).

Technical Infrastructure: Among technical infrastructure factors, "graphics workstation performance" had the greatest impact ($\beta=0.65$), followed by network environment ($\beta=0.32$, $p<0.001$).

Student Characteristics: Among student characteristics, "independent learning ability" had a higher contribution ($\beta=0.62$) than "artistic foundation" ($\beta=0.38$, $\beta=0.21$, $p<0.01$).

Mediating Effect: The mediating effect of university-enterprise cooperation was significant. For example, the teaching effectiveness of Dalian Art College increased by 28% after cooperating with enterprises .

Interaction Effect: In institutions with high hardware configuration, each level increase in faculty AI literacy led to a 0.51-level increase in teaching effectiveness; while in institutions with low hardware configuration, the increase was only 0.28-level. This indicates that priority should be given to the coordinated configuration of "hardware-faculty" to avoid single-input inefficiency.

4.4 Path Differences Between Undergraduate and Junior Colleges

Table 3. Comparison of Path Coefficients of AI Teaching Influence Between Undergraduate and Junior Colleges

Path	Undergraduate Institutions (β)	Junior Colleges (β)	Difference Test $\Delta\chi^2$	p-value
Faculty Team Teaching Effectiveness	0.45	0.36	7.23	<0.01
Technical Infrastructure Teaching Effectiveness	0.35	0.28	4.15	<0.05
Student Characteristics Teaching Effectiveness	0.16	0.32	9.86	<0.001
Mediating Effect (University-Enterprise Cooperation)	0.18	0.09	6.87	<0.01

Undergraduate Institutions: The impacts of faculty team (β=0.45) and the depth of university-enterprise cooperation (mediating effect=0.18) were more significant, reflecting that undergraduate institutions rely more on systematic faculty support and university-enterprise cooperation.

Junior Colleges: The impact of students' independent learning ability (β=0.32) was significantly higher than that in undergraduate institutions (β=0.16), while the impact of technical infrastructure (β=0.28) was lower than that in undergraduate institutions (β=0.35). This suggests that junior colleges can alleviate the shortage of hardware and faculty by strengthening students' independent learning.

Specific path coefficient differences are shown in Table 3.

5. Discussion on Results and Practical Implications

5.1 Comparison with International Studies

Commonality: Both this study and international research (Brown et al., 2024, Creative Arts University, UK) identified "faculty competence" as the primary influencing factor (international β=0.35 vs. this study β=0.42), confirming the core role of teachers .

Difference: The impact of "hardware configuration" in international studies (β=0.28) was lower than that in this study (β=0.32), and no significant effect of "students' independent learning ability" was found in international studies. This is closely related to the local characteristics of resource constraints in Chinese private colleges and universities (e.g., large hardware gaps: 1 graphics workstation per 15 students in junior colleges vs. 1 per 4 students internationally).

This study is the first to reveal the "mediating role of university-enterprise cooperation" and the "interaction effect between hardware and faculty", which has not been reported in international similar studies. The main reasons are: (1) Most international colleges and universities are public with sufficient resources, so they do not need to rely on university-enterprise cooperation to make up for hardware shortages; (2) The "self-funded" nature of Chinese private colleges and universities determines that university-enterprise cooperation is an important path for resource integration, and the coordinated configuration of "hardware-faculty" can maximize the benefits of limited resources. This finding provides Chinese experience for AI teaching in "resource-constrained colleges and universities" worldwide.

5.2 Hierarchical Improvement Strategies

Faculty Training: Referring to the "AI Teaching Competence Certification System" of the California Institute of the Arts, a training system with the structure of "technical operation (30%) + teaching design (50%) + artistic creativity guidance (20%)" was constructed, with 40 hours per semester (including 16 hours of practical teaching by enterprise tutors). The goal is to enable 80% of teachers to master AI course development capabilities.

Deepening University-Enterprise Cooperation: Jointly establish "AI Animation Joint Laboratories" with animation enterprises, adopting the model of "enterprises invest 60% of hardware + schools provide venues" to ensure the graphics workstation configuration reaches "1 unit per 6 students". At the same time, introduce real enterprise projects (e.g., short video animation production) as AI teaching cases to improve teaching practicality .

Support for Students' Independent Learning: Develop "AI Animation Learning Resource Packs" (including Stable Diffusion open-source tutorials and university-enterprise cooperation case databases), and build an online Q&A platform (with 3 sessions of online tutoring by enterprise tutors per week). The goal is to increase the proportion of students who "use AI tools ≥3 times a week" from 32% to 50%.

Targeted Hardware Optimization: Prioritize hardware configuration for core courses (e.g., "Digital Painting", "Character Design"), adopt a hybrid model of "cloud-based AI tools + local basic equipment" (e.g., using Alibaba Cloud rendering farms to make up for insufficient local computing power), and concentrate limited funds (30,000 RMB per year) on key equipment updates to avoid resource dispersion.

6. Research Conclusion and Future Prospects

6.1 Research Limitations

Sample Representativeness: The samples only cover 5 private colleges and universities in Liaoning Province, not including animation industry-developed regions such as the Yangtze River Delta and Pearl River Delta. Regional differences may exist (e.g., more abundant university-enterprise cooperation resources in industry-developed regions may lead to different impact intensities of influencing factors).

Variable Dimension Expansion: Emerging variables such as "AI technology ethics education" and "interdisciplinary collaboration (e.g., joint teaching between animation and computer majors)" were not included. However, international studies (Smith et al., 2023) have confirmed that AI ethics cognition has a significant impact on the standardization of students' creative expression [10].

Lack of Longitudinal Tracking: Cross-sectional data (March-April 2024) was used, which cannot observe the dynamic changes of influencing factors caused by the "duration of AI teaching implementation" (e.g., the role of students' independent learning ability may gradually weaken in institutions with long-term AI teaching).

6.2 Future Research Directions

Expanding Samples and Regional Comparison: Plan to conduct cross-regional surveys in cooperation with colleges and universities in Jiangsu, Guangdong and other provinces (target sample size ≥1000) to analyze the differences in influencing factors of AI teaching in private colleges and universities between industry-developed and underdeveloped regions, and explore specific paths for "industry resources feeding back teaching".

Expanding Variables and Deepening Mechanisms: Introduce variables such as "AI ethics cognition" and "interdisciplinary teaching frequency" to test their moderating effects on the pathway "Faculty Competence → Teaching Effectiveness". At the same time, use interview methods to deeply explore the specific behavioral patterns of "students' independent learning ability replacing hardware shortages" (e.g., "how to make up for equipment gaps through self-study of open-source tools") [10].

Conducting Longitudinal Tracking Research: Conduct a 2-year follow-up survey on the current 312 sample students (covering 1 year after graduation) to analyze the long-term impact of AI teaching effectiveness on students' employment quality (e.g., employment rate in animation enterprises, starting salary level), and further verify the practical value of research conclusions.

International Cooperation and Comparative Research: A cooperation intention has been reached with the Creative Arts University (UK) to carry out the "Comparative Study on Influencing Factors of AI Teaching in Chinese and British Private Colleges and Universities", focusing on analyzing the impact of "resource input models (public subsidies vs. private self-funding)" on the mechanism of influencing factors, and providing a cross-cultural perspective for AI education in private colleges and universities worldwide .

Acknowledgments

This study is a phased research achievement of the 2025 project "Research on AI-Enabled Teaching Mode in Animation Major of Private Colleges and Universities — A Case Study of Liaoning Province", which is approved by the Liaoning Private Education Association. Project Number: LMJX2025166.

References

[1] European Commission. AI for Education: A European Policy Framework [R]. Brussels: European Commission Publications Office, 2023.

[2] National Science Foundation. National AI R&D Strategic Plan: 2024 Update [R]. Washington, DC: NSF, 2024.

[3] LI M, ZHANG H. Research on the reform path of art design education in private colleges and universities in the AI era [J]. Research in Educational Development, 2024, 44(5): 78-85.

[4] VENKATESH V, NEVES C, OLIVEIRA T, CRUZ-JESUS F. Extending the unified theory of acceptance and use of technology for sustainable technologies context [J]. International Journal of Information Management, 2025, 80: 102838.

[5] LI H J, ZHANG F. An empirical study on the acceptance model of college students' mobile learning based on UTAUT model [J]. Information Science, 2017, (6): 98-103.

[6] ZHAO Y, CHEN J. Advanced application of structural equation modeling in educational quantitative research [J]. Psychological Development and Education, 2025, 41(2): 256-263.

[7] BROWN J, WILSON S. Factors influencing AI integration in animation education: Evidence from UK private colleges [J]. Computers & Education, 2024, 198: 105432.

[8] WHITE A, et al. Industry-university collaboration in AI animation training: Evidence from California [J]. Animation Studies, 2024, 18: 67-89.

[9] SUN Y, LI G. Application standards and case analysis of Bootstrap method in educational research [J]. Journal of Educational Studies, 2024, 20(1): 79-88.

[10] SMITH L, et al. AI-assisted creativity in art schools: A cross-national study of 12 countries [J]. Journal of Educational Technology & Society, 2023, 26(2): 45-62.