Scilight

Journal of Educational Technology and Innovation
https://jeti.thewsu.org/index.php/cieti

Article

Analyzing Multimodal Teaching Behaviors in College Dance Education: A Technology-Integrated Approach with Lag Sequential Analysis

Ming Zhang [1,*], Fangyuan Chen [2] and Yan Mo [3]

[1] College of Music, Guangdong Polytechnic Normal University, Guangzhou 510665, China
[2] School of Education, City University of Macau, Macau
[3] School of Chinese Language and Literature, South China Normal University, Guangzhou 510006, China
* Correspondence: mzhang@gpnu.edu.cn

How To Cite: Zhang, M., Chen, F & Mo, Y. (2026). Analyzing Multimodal Teaching Behaviors in College Dance Education: A Technology-Integrated Approach with Lag Sequential Analysis. *Journal of Educational Technology and Innovation*, *8*(1), 1–11. https://doi.org/10.61414/7cegk338

Received: 28 November 2025
Revised: 8 January 2026
Accepted: 5 March 2026
Published: 31 March 2026

Abstract: The integration of information technology is introducing a new paradigm for dance classroom teaching in higher education, moving beyond the traditional, teacher-centered approach of oral transmission and physical demonstration. To investigate the effectiveness of the technology-enhanced teaching model in higher education dance courses, this study constructed a multimodal classroom behavior analysis coding system containing 23 teaching modes specifically designed for dance classroom characteristics. Using videos recorded a university's Dance course (N=72 students, 8 sessions) as a corpus, a learning analysis model was designed to annotate and analyze the multimodal behaviors in technology-integrated and traditional dance classrooms. Through lag sequential analysis and quantitative analysis of behavior coding, the results indicated that high-frequency modal combinations synergistically enhance the teaching effect, boosting knowledge transfer efficiency, cultural understanding, creative practice, and teacher-student interaction. The technology-integrated classroom demonstrates regular patterns in dance teaching behavior sequences. Furthermore, while both traditional and multimodal classrooms utilize language and movement, the multimodal approach emphasizes student-centered pedagogy and integrated educational technology, thereby expanding the use of non-body modalities such as video. These findings not only provide empirical evidence for optimizing technology integration in dance pedagogy but also establish a behavioral-level analytical framework for future research in performing arts education.

Keywords: dance education; multimodal teaching; behavior coding; lag sequential analysis; classroom interaction

1. Introduction

Traditional dance education primarily follows a teacher-centered approach centered on verbal instruction and physical demonstration, resulting in a relatively uniform teaching methodology (Li & Ahmad, 2025). Due to constraints in instructional time and space, the conventional "demonstration–imitation–practice" cycle often limits teachers' awareness of multimodal meaning construction (Xu, 2023), the cultivation of diverse communicative skills, and the application of multimodal teaching strategies. Furthermore, the dynamic interaction between teaching and learning elements lacks depth and integration (Zhou, 2025). Multimodal teaching can promote students' interdisciplinary learning, cultivate their expressiveness, creativity, and teamwork abilities, and contribute to the comprehensive development of educational objectives (Wang & Yu, 2024). Implementing multimodal teaching models in university dance classrooms can construct comprehensive teaching scenarios,

enrich instructional procedures, encourage knowledge integration, stimulate multiple intelligence, and effectively address issues such as limited traditional teaching resources, inadequate teaching conditions, and practical implementation challenges (Cohn et al., 2025). However, in recent years of exploration, the multimodal approach in university dance education and its role in optimizing teaching have not received sufficient attention.

In fact, understanding dance instructors' classroom teaching models that integrate technology holds dual significance: on one hand, it promotes deeper reflection on the teaching process, provides detailed feedback and improvement suggestions, and achieves higher-quality AI-driven holistic education through technological intervention; on the other hand, it offers a basis for interpreting teaching effectiveness in the dance classroom and establishes connections with specific teaching process and mode (Zhang & Wang, 2024). Therefore, as teachers' information and communication technology (ICT) competencies gradually improve and learning analytics advances, this study collects behavioral performance data from instructors, transforms it into structured knowledge, and provides empirical evidence at the behavioral level. This approach accelerates the application of technology in dance classrooms, supports the professional development of university dance instructors, and advances the goal of cultivating innovative talent through dance teaching.

2. Literature Review

2.1. The Concept and Educational Applications of Multimodal Teaching

Multimodal learning encompasses auditory, visual, kinesthetic, and linguistic learning modes, playing a crucial role in the field of education (Lee et al., 2023). From the perspective of classroom teaching, multimodality is a teaching method that enhances the symbolic system of teaching and enhances the expressive power of teaching, offering distinct advantages in developing the competencies in all aspects of higher education learners (Rahmanu & Molnár, 2024). From the perspective of evaluation, multimodality is a method of analyzing and judging the rationality of classroom teaching behaviors, demonstrating significant potential in understanding student learning processes and predicting outcomes (Moon et al., 2024). Furthermore, the effective implementation of such multimodal analysis in educational settings often requires a supportive framework that balances technological empowerment with normative discipline, a challenge also noted in broader contexts of AI integration in higher education (Fu et al., 2025). According to the New London Group (1996), Pedagogy of Multiliteracies is a teaching method that uses different modalities to construct meaning through the integration of text and digital resources, emphasizing the inseparability of the body and the brain through multimodal and multisensory collaboration. Multimodal teaching approaches not only guide and support teacher feedback but also foster student collaboration in complex, open-ended environments, addressing challenges students encounter during collaborative work (Cohn et al., 2025).

2.2. Technology-Integrated Multimodal Pedagogy in Higher Dance Education

The teaching of dance majors is based on collective teaching, teachers convey knowledge through the body, and their teaching content and results are based on the dynamic presentation of the body. Performance arts grounded in physical movement can enhance embodied experiences and emotional engagement, but they also require teaching methods based on embodied transformative learning (Cappello et al., 2024).

With the deep integration of information technology and artificial intelligence, the paradigm of dance education is undergoing reconstruction. At the level of technological application, Wu and Zhao (2024) proposed a hybrid density network algorithm to address issues such as insufficient simulation accuracy and poor real-time responsiveness in multimedia interactive choreography, offering a new solution for creative interactive dance composition. Concurrently, the development of new media platforms is systematically reshaping teaching processes. By integrating media platforms, specialized content, and instructional systems, these platforms effectively enhance students' artistic literacy (Song & Liu, 2024). In teaching practice, digital tools demonstrate multifaceted value: technologies like video recording serve not only for feedback and assessment but also help dancers deepen their understanding of their own movement patterns, functioning as supplementary teaching tools (Demian, 2024). The introduction of AI has brought more disruptive changes. Zhou et al. (2024) developed a teaching system based on diffusion modeling and virtual digital humans. This system generates dance sequences from music and demonstrates them in real time through virtual instructors, thereby enhancing learning engagement and movement diversity. From a broader perspective, this technological convergence not only revolutionizes teaching methods but also shoulders the mission of cultural preservation. By integrating ICT and AI technologies, dance education modernizes while enhancing student creativity, simultaneously serving as a vital medium for safeguarding cultural heritage and promoting sustainable development (Huang et al., 2025).This approach resonates with the push towards more integrated frameworks for understanding human-AI collaboration in other

skill-based subjects, such as language education (Yang et al., 2025), highlighting a cross-disciplinary trend.It can be seen that the dance multimodal teaching model supported by technology has the incomparable advantages of traditional teaching, which is feasible and breakthrough in improving the efficiency of college dance teaching, cultivating learners' understanding of multiple knowledge and innovation ability, optimizing the effect of classroom teaching, and advancing the process of reforming college dance teaching.

As illustrated in Figure 1, the multimodal teaching of college dance is conceptualized within a framework that integrates multimodal teaching models, methods, and assessment. This approach utilizes modern multimedia and three-dimensional teaching resources to present dance culture and contexts. It operates through the synergistic engagement of multiple senses, such as auditory, visual, and tactile, and leverages diverse semiotic resources including language, sound, imagery, movement, and space. Through this multi-interactive process of dance learning, the framework aims to foster students' multimodal knowledge construction.

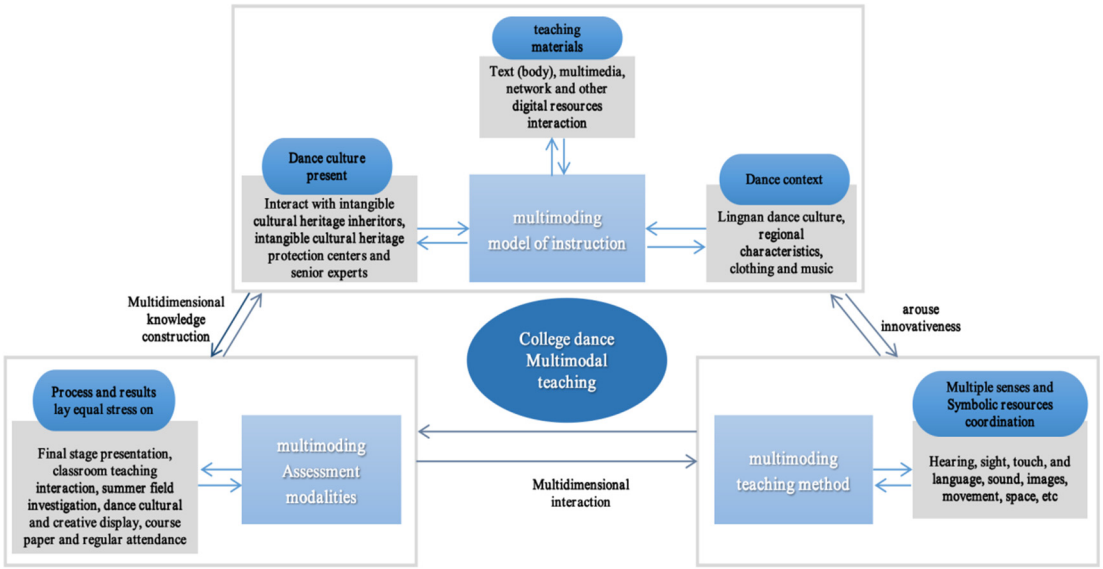

Figure 1. Framework diagram of the multimodal teaching model for dance in higher education**.**

2.3. Analyzing Teaching Behaviors in Higher Dance Education

From the definition of teachers' teaching behavior, it can be learned that teachers' teaching behavior will be affected by teachers' educational thinking, teaching philosophy, teaching skills, and other factors; at the same time, teachers' teaching behavior also reflects teachers' teaching intentions (Li et al., 2024). In teaching practice, the selection of instructional styles is crucial, as different teaching behaviors can influence classroom dynamics. For instance, adopting a problem-solving style can effectively engage students' emotions and motivation by promoting cooperative learning and group sharing, demonstrating unique value in dance instruction (de Las Heras-Fernández et al., 2025). To optimize these teaching behaviors, critical observation serves as an effective method for examining and reflecting on multimodal interactions between teachers and students, deepening educators' understanding of their own instructional practices (McCabe & Risner, 2025). In instructional model innovation, deep technology integration has become a trend. For instance, the SPOC teaching model, constructed based on deep learning theory, effectively enhances students' professional competence and learning initiative by analyzing online learning behaviors and predicting academic performance (Ding, 2024). Multimodal teaching behaviors of university dance instructors constitute a vital component of the teaching behavior system. These instructional activities are meticulously designed by teachers according to teaching objectives and content, with their formation process profoundly influenced by educational philosophies.

Analysis and improvement of teachers' instructional practices can effectively enhance classroom teaching effectiveness and contribute to achieving the competency goals of cultivating innovative talent. The deep integration of digital technology has significantly expanded the breadth and depth of dance instructors' multimodal teaching behaviors, transforming their role from mere skill teaching to multimodal instruction that integrates resources, guides learning, and promotes interaction (Song, 2024). Specifically, artificial intelligence technologies provide a powerful foundation for educational management reform. By conducting multidimensional analyses of teaching and learning data, they offer data-driven support for teachers to adjust instructional strategies and achieve personalized instruction, significantly enriching the modalities of classroom teaching practices (Zhang, 2024).

However, at the practical level, implementing multimodal teaching still faces challenges such as disconnects between curriculum and practice, as well as resource inequality, particularly in vocational institutions. Addressing these requires strategies like optimizing curriculum systems and strengthening industry-school collaboration (Yin, 2024). Systematically constructing and implementing multimodal teaching requires educators to responsibly integrate tools like AI, moving beyond mere application to ethical and systemic dimensions. This ensures educational equity and humanistic care are upheld within technology-integrated multimodal teaching (Daher, 2025).

3. Research Method

3.1. Research Questions and the Present Study

Multimodal teaching has become a trend in the development of dance teaching modes in colleges and universities. However, due to the rich spatial movement changes in dance, in the implementation of specific dance courses, dance teaching is mainly based on physical movement, which is very different from the traditional classroom teaching in the form of language-based education, and the pursuit of on-the-spot performance is more urgent. However, there is a lack of behavioral research on physical movement, so only referring to the research results of other disciplines cannot fully express the behavioral significance of dance teaching, nor can it prove the effectiveness of multimodal teaching. Therefore, this study aims to fill this gap by constructing a behavior coding system suitable for dance teaching and using lag sequential analysis method to provide empirical evidence based on behavior sequence for the effectiveness of dance multimodal teaching.

Based on the above phenomenon, this paper analyzes the multimodal teaching of dance in colleges and universities through eight selected teaching video examples (four each of traditional teaching and multimodal teaching), so as to put forward suggestions for improvement. The specific research questions are as follows: (1) What are the main multimodalities used in college dance teaching and what are the characteristics of modal distribution? (2) What are the patterns of behavioral state transfer at different teaching stages in the teaching process? (3) What kind of homogeneity and differences exist between traditional and multimodal dance teaching modes?

3.2. Context and Participants

This study draws on the lesson “Paiyao Long Drum Dance” at University G, a traditional dance of the Yao ethnic group in Lingnan, China. The lesson functions as a professional elective for second-year undergraduate students majoring in Dance Studies within a teacher education program, combining both practical training and theoretical instruction. A total of 72 students from two parallel classes participated in the course. Class A served as the experimental group employing a multimodal teaching approach, while Class B functioned as the control group using traditional dance teaching methods.

The course content is designed to help students master foundational theoretical knowledge and basic movement skills of Lingnan Dance, specifically the Paiyao Long Drum Dance. It also seeks to implement the educational philosophy of “integrated development of the five educations”, including moral, intellectual, physical, aesthetic, and labor education, with special emphasis on aesthetic education. Through this approach, the course aims to cultivate students’ innovative and practical abilities, uphold professional standards, and integrate ideological and political education into the curriculum. Additionally, it guides students to develop a value system centered on truth, goodness, and beauty, understand the relationship between theory, creation, and teaching, interpret the traditional cultural significance embedded in dance movements, and ultimately inspire students to consciously appreciate and pass on the profound aesthetic and ethical values inherent in China’s outstanding traditional culture.

3.3. Theoretical Framework

Based on the characteristics of Lingnan dance courses, this study classified teacher-student interaction behaviors in classroom teaching through systematic analysis of classroom video recordings. Building on the Flanders Interaction Analysis System (FIAS), the modal types employed in classroom teaching were further refined. By integrating Zhang Delu’s (2009) Comprehensive Framework for Multimodal Discourse Analysis and the Framework for Dominant Factors in Modal Choice, a structured analytical framework consisting of 19 modality types was developed for examining dance classroom teaching behaviors, as summarized in Table 1.

These modal types can be categorized into “language” and “non-verbal” modalities. “language” modalities encompass the teacher’s spoken language, singing language, and written language; para-language includes sound effect, prop, tone, formation, and costume. “Non-verbal” modalities comprise both body and non-body

components. The body component includes action, simulation, facial expression, body expression, gesture, and stance; the non-body component encompasses PPT presentation, the internet, image, video, and the environment.

Table 1. Multimodal behavior analysis framework for dance classroom teaching in higher education**.**

Modal Type		Teaching Stage	Synergy & Function	Discourse Meaning
Language	Pure Language	Spoken Language	Primary Modality: Leads the course progress	Ideational, Interpersonal, and Discourse Meaning
		Singing Language	Reinforcement Relation: Highlights the cultural characteristics of the Pai Yao Long-drum Dance	Ideational, Interpersonal, and Discourse Meaning
		Written Language	Supplementary & Optimizing Relation: Deepens understanding of the cultural characteristics of the Pai Yao Long-drum Dance	Ideational, Interpersonal, and Discourse Meaning
	Para-language	Sound Effect	Auxiliary & Reinforcement Relation: Provides musical cultural background, enhances attractiveness	Discourse Meaning
		Prop	Primary Modality: Assists teaching	Discourse Meaning
		Tone	Supplementary & Reinforcement Relation: Expresses emotion, poses questions, emphasizes key and difficult points	Interpersonal and Discourse Meaning
		Formation	Supplementary Relation: Assists teaching, strengthens students' understanding of the Yao ethnic temperament	Discourse Meaning
		Costume	Optimizing Relation: Highlights and expands body language expression; discovers the beauty of costume, cultivates interest, and improves aesthetic ability	Interpersonal and Discourse Meaning
Non-verbal	Body	Action	Primary Modality: From basic cognition to intuitive perception, deepens knowledge construction of the Yao ethnic group's extensive cultural heritage	Ideational, Interpersonal, and Discourse Meaning
		Simulation	Supplementary & Optimizing Relation: Generates cognition of Yao culture from the distinctions between real life and ethnic culture, stimulating innovative awareness	Interpersonal and Discourse Meaning
		Facial Expression	Supplementary & Optimizing Relation: Provides encouragement and affirmation	Interpersonal Meaning
		Expression (Body)	Auxiliary Relation: Obtains information, releases information, controls the classroom	Interpersonal Meaning
		Gesture	Supplementary & Optimizing Relation: Enhances attractiveness	Interpersonal Meaning
		Stance/Posture	Supplementary & Optimizing Relation: Enhances attractiveness	Interpersonal Meaning
	Non-body (Tool)	PPT	Auxiliary & Reinforcement Relation: Experience the passing down of the Pai Yao spirit, connecting ethnic temperament with oneself	Ideational and Textual Meaning
		Internet	Auxiliary & Reinforcement Relation: Breaks field and contextual boundaries for interaction; recognizes the "vitality" origin naturally revealed in the dances of veteran artists	Ideational, Interpersonal, and Textual Meaning
		Image	Auxiliary & Reinforcement Relation: Experience the passing down of the Pai Yao spirit, connecting ethnic temperament with oneself	Ideational and Textual Meaning
		Video	Auxiliary & Reinforcement Relation: Experience the passing down of the Pai Yao spirit, connecting ethnic temperament with oneself	Ideational and Textual Meaning
		Environment	Supplementary & Optimizing Relation: Enhances attractiveness, improves teaching effectiveness	Interpersonal and Textual Meaning

3.4. Methods and Tools

This study employed the ELAN 6.3 multimodal corpus annotation tool to annotate the corpus. Based on the behavioral analysis framework presented in Table 1, the ELAN software facilitated multilevel annotation of multimedia elements, including teacher speech, gaze, gesture, posture, and video footage. These annotations were conducted at three-second intervals throughout one instructional session, resulting in a coding table presented in Table 2. The FIAS coding system only selects single teaching-interaction behaviors for analysis, rendering it unsuitable for scenarios in dance instruction where verbal and physical actions occur simultaneously. To address this, this paper innovatively employs a coding-based color annotation technique, providing a visual annotation solution for multiple concurrent behaviors (see Figure 2).

The analytical method applied is Lag Sequential Analysis (LSA), primarily used to test statistically significant differences between behavioral sequences and thereby explore human behavioral patterns. As a learning analytics method, LSA has gained recognition as an effective approach for analyzing sequences of learning and teaching behaviors. Common tools for conducting LSA include Enterprise Miner, IntelligentMiner, and GSEQ.

Among these, GSEQ was selected for this study due to its streamlined behavior analysis workflow and enhanced data processing efficiency compared to the other tools. Therefore, this study employs GSEQ 5.1 for LSA.

Table 2. Behavior coding.

Behavior	Code	Behavior	Code
Instruction	IT	Student Formation Choreography Practice	SD
Guidance/Direction	GD	Teacher Dance Demonstration	TDD
Asking Questions	AQ	Student Dance Practice	SDP
Praise/Encouragement	PE	Comparative Analysis of Dance Moves	CA
Active Response	TR	Student Practical Creation & Demonstration	SPD
Taking Initiative to Question	TI	Smiling, Giving Affirmation	SA
Small Group Discussion	SGD	Scanning the Whole Class	SC
Teacher Humming/Musical Accompaniment	MA	Looking at an Individual	LI
Teacher Plays Dance Music	DM	Encouraging Gesture	EG
Teacher Prop Training	TRT	Accompanying Gesture to Prompt Student Moves	AG
Student Prop Training	SRT	Video Presentation of Dance	VP
Teacher's Intonation	TUI	Classroom Roaming/Proximity	CR

0 seconds	3seconds	6seconds	9seconds	12seconds	15seconds	18seconds	21seconds	24seconds	27seconds	30seconds	33seconds	36seconds	39seconds
0 minutes	GD	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT
1 minute	GD	SDP	SDP	GD	GD	GD	SDP	SDP	SDP	SDP	SDP	SDP	SDP
2 minutes	SDP	SDP	SDP	SDP	SDP	SDP	SDP	SDP	SDP	SDP	GD	TUI	SA
3 minutes	IT	IT	IT	IT	GD	GD	GD	IT	IT	IT	IT	GD	GD
4 minutes	SDP	SDP	SDP	SDP	SDP	GD	SC	SC	GD	GD	GD	GD	GD
5 minutes	SDP	SDP	LI	GD	GD	LI	IT	IT	IT	GD	IT	IT	AQ
6 minutes	SRT	SRT	PE	GD	GD	SRT	SRT	SRT	IT	IT	IT	TRT	TRT
7 minutes	GD	GD	GD	TRT	TRT	TRT	SRT	SRT	SRT	SRT	GD	PE	GD
8 minutes	GD	GD	GD	GD	SDP	SDP	SDP	SDP	SDP	SDP	SDP	SDP	SDP
9 minutes	SDP	SDP	SDP	SDP	SDP	SDP	SDP	SDP	SDP	SDP	SDP	SDP	SDP

Teacher Prompt Proxemics

Figure 2. Quantitative coding table of teaching recordings (excerpt).

The procedure for applying GSEQ to analyze behavioral sequences in collegiate dance teaching involves the following main procedures: (1) organizing the coded classroom teaching behavior data into a format comprising sequence numbers and behavioral sequences in terms of class hour; (2) Import the organized data into GSEQ to generate a behavior transition frequency table and an adjustment residual table; (3) Identify patterns with significant behavior sequences by screening the adjustment residual table, and use Gephi to draw behavior transition diagrams.

4. Results and Discussion

4.1. Data Analysis

The frequency of multimodal behavioral state transition of teachers for one dance session generated by GSEQ is shown in Figure 3, where the rows indicate the initial behavior, the columns indicate the subsequent target behavior and the coding indicates the frequency of target behavior following initial behavior. For example, the number corresponding to the third row and fifth column in Figure 3 is 10, which means that the frequency of the teacher's asking questions (AQ) followed by the student's active response (TR) occurs 10.

GSEQ transforms the data in the frequency table to obtain the corresponding residual table, which is the residual value (Z-score) adjusted for the frequency of the behavioral sequence. According to the principle of lag sequential processing, Z-score > 1.96 means that the behavioral sequence is significant, screening and organizing behavioral sequences that are significant in the residual table of dance teaching behavioral sequences, there are 30 behavior sequences greater than 1.96. In the form of edge table {source, target, weight} to draw the behavioral state transition diagram of dance teachers, as shown in Figure 4. The nodes in the diagram represent the multimodal behaviors of dance teaching, the edges connect two behaviors that occur consecutively, and the arrows indicate the direction of behavioral transitions. The larger the number on the node, the higher the frequency of the behavior, meaning the higher the possibility that the behavior represented by the next node will occur after the behavior represented by the previous node.

	IT	GD	AQ	PE	TR	TI	SGD	MA	DM	TRT	SRT	TUI	SD	TDD	SDP
IT	0	14	1	0	0	0	0	0	0	1	0	1	0	0	0
GD	8	0	3	4	1	0	0	0	0	1	1	1	0	0	10
AQ	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0
PE	3	4	1	0	0	0	0	0	0	0	0	0	0	0	2
TR	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0
TI	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SGD	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1
MA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRT	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
SRT	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0
TUI	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0
SD	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
TDD	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SDP	0	7	0	4	0	0	0	0	0	0	0	0	0	0	2
CA	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
SPD	0	2	0	1	0	0	1	0	0	0	0	0	0	0	0
SA	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0
SC	6	3	0	0	0	0	2	0	0	0	0	1	0	0	0
LI	1	2	3	0	1	0	0	0	0	0	0	0	0	1	0

Figure 3. Transition frequency of the dance teacher's multimodal behaviors (excerpt)**.**

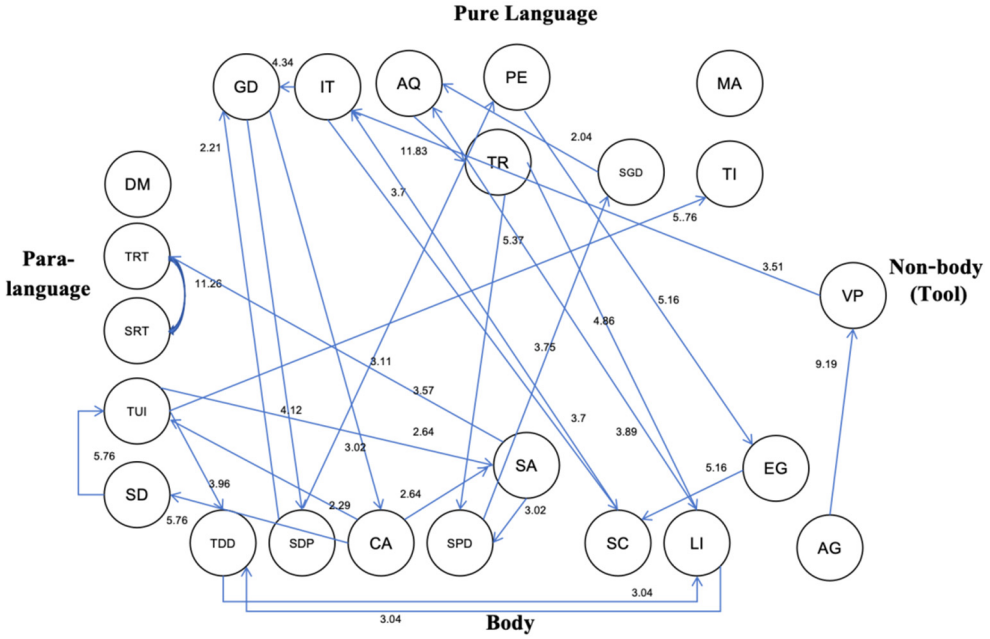

Figure 4. State transition diagram of dance multimodal teaching behaviors**.**

4.2. Synergistic Effects of High-Frequency Modalities

The lag sequential analysis revealed several significant high-frequency modal combinations. These synergies were not random but formed coherent instructional clusters, each achieving a distinct pedagogical effect. Specifically, we identified four key synergistic patterns that contributed to promoting knowledge transfer, enhancing cultural understanding, fostering creative practice, and deepening teacher-student interaction. The following sections will illustrate these patterns from classroom observations.

4.2.1. Promoting Knowledge Transfer

"Verbal instructions + movement demonstrations + props + analogies" is a set of high-frequency modal combination to help students understand and master dance movements. Teachers primarily convey key movement points verbally, demonstrate movements personally, compare them with standard postures, and promptly correct any deviations from proper form. For example, when teaching traditional movements of the Yao Long Drum Dance, the teacher holds a traditional bamboo sheet and the props of the long drum, and shows the students the traditional movements and rhythmic patterns of the Paiyao long drum dance. Through this visual demonstration, students then practice the dance movements. During this process, the teacher provides verbal cues and explanations while leading students in performing the traditional movement together. Through multimodal instruction

integrating verbal language, physical demonstration, analogy, and eye contact with hand gestures, students effectively master and flexibly apply the traditional dance movement of hand-held bamboo striking a drum in the Guangdong Paiyao Long Drum Dance, experiencing the harmonious unity of movement and rhythm. The interaction of multiple modalities embodies conceptual, interpersonal, and discourse meanings.

4.2.2. Enhancing Cultural Understanding

"Verbal instructions + formation + video + analogies" is a set of high-frequency modal combinations, based on the sound, video, formation demonstrations and comparison, exploring the folk traditional forms, derivative forms, and stage performance forms of the Paiyao Long Drum Dance. This approach guides students from foundational knowledge to intuitive experiences of the distinctions between real life and ethnic culture, allowing them to feel the enduring spirit of the Paiyao people. It connects the seemingly intangible essence of ethnic identity with their own experiences. For example, in the situational teaching exercise, the teacher plays videos showcasing the folk traditional forms, derivative forms, and stage performance works of Paiyao Long Drum Dance. Students engage in discussions, exploring regional characteristics and folk culture to identify the dance's steady, simple and bold style features. Students then form a circle formation, immersing themselves in the atmosphere of a traditional Yao ethnic festival. By engaging students' multiple senses in coordinated participation and employing group discussions, the identified cultural clues of the Yao ethnic group are analyzed and supplemented.

4.2.3. Fostering Creative Practice

"Formation + movement demonstrations + analogies" is a set of high-frequency modal combinations, cultivating students' innovative thinking through comparing movements and collaborative group creation. For example, the teacher summarizes the key techniques of the traditional Paiyao long drum dance and the characteristics of the "integration of drumming and dancing", then guides the students to refine, develop, and create the dance movement elements in groups. Through the form of group cooperative creation and practice, students discuss and evaluate each other within and between groups to deepen their understanding of the Paiyao culture and its innovative transformation. This approach fosters student initiative while fully realizing their central role in learning, cultivating skills in critical thinking, problem identification, and innovative thinking.

4.2.4. Deepening Teacher-Student Interaction

"Verbal instructions + intonation + facial expressions + body" is a set of high-frequency modal combinations, mainly through modal synergy to attract students' attention, so that students are deeply involved in classroom interaction to improve the teaching effectiveness. Teachers pose questions and engage in open-ended Q&A with students regarding easily confused movements, such as horizontal drum swings, lifting-and-pressing techniques, and circular motions, while summarizing the value embodied in the Paiyao Long Drum Dance. Secondly, students are encouraged and guided to break the traditional classroom space and go into the folk communities, traditional festival sites, and the homes of cultural inheritors to construct non-traditional teaching environments. They can collect and organize the original materials such as the movement elements of the Lingnan traditional dance, the performance routines, the composition and scheduling, and the costumes and props, etc. Recognizing the natural vitality expressed in the dances of elderly artisans makes contextual knowledge acquisition more concrete. On the basis of folk, this approach guides students to conduct in-depth exploration of the distinctive styles and cultural connotations inherent in dance forms, rooted in national spirit and cultural essence. Fostering a deep appreciation for and confidence in traditional Chinese culture, while simultaneously cultivating students' understanding of diverse knowledge through interactive learning.

4.3. Comparative Analysis of Traditional and Multimodal Classrooms

In this paper, we conducts a coding analysis of instructional videos from traditional classrooms and multimodal classrooms, and Table 3 shows the basic structure of instruction within these two classroom environments. From the perspective of "spoken language", instruction (IT) and guidance/direction (GD) behaviors are high-frequency behaviors. However, the multimodal classroom featured significantly higher proportions of praise/encouragement (PE, 2.19%), active response (TR, 3.59%), and small group discussion (SGD, 2.81%). This indicates that the multimodal classroom prioritizes cultivating students' higher-order thinking skills, embodying a student-centered philosophy. From the perspective of "body", the traditional classroom in which teachers dance demonstration (TDD, 33.41%) and students dance practice (SDP, 22.78%) occupy more than half of the classroom time, the multimodal classroom has more comparative analysis of dance moves (CA, 2.97%) and students practical

creation and demonstration (SPD, 2.81%), which encourages students' innovative thinking and has paid attention to a deeper application of technology in teaching and learning. From the perspective of "non-body", the multimedia presentation function represented by the video presentation of dance (VP) occupies 28.91%, which is generally not available in the traditional classroom. In the early teaching phase of the multimodal classroom, video demonstration is generally used to make students understand the dance culture, and in the later phase of the classroom, video demonstration is mainly used to help students understand the stage presentation of dance movements.

Table 3. Traditional and multimodal classroom behavior ratio statistics table**.**

Modal Type		Sub-Category		Multimodal Classroom			Traditional Classroom	
					Number of Annotations	Time Proportion	Number of Annotations	Time Proportion
Language	Pure Language	Spoken Language	Teacher	IT	72	11.25%	47	10.20%
				GD	91	14.22%	68	14.75%
				AQ	6	0.94%	8	1.74%
				PE	14	2.19%	3	0.65%
			Student	TR	23	3.59%	4	0.87%
				TI	2	0.31%	0	0.00%
				SGD	18	2.81%	0	0.00%
		Singing Language	MA	0		0.00%	0	0.00%
	Para-language	Sound Effect	DM	0		0.00%	28	6.07%
		Prop	TRT	9		1.41%	2	0.43%
			SRT	14		2.19%	0	0.00%
		Tone	TUI	7		1.09%	17	3.69%
		Formation	SD	18		2.81%	0	0.00%
Non-verbal	Body	Action	TDD	6		0.94%	154	33.41%
			SDP	107		16.72%	105	22.78%
		Simulation	CA	19		2.97%	7	1.52%
			SPD	18		2.81%	0	0.00%
		Facial Expression	SA	5		0.78%	1	0.22%
		Expression (Body)	SC	14		2.19%	14	3.04%
			LI	8		1.25%	3	0.65%
		Gesture	EG	3		0.47%	0	0.00%
			AG	1		0.16%	0	0.00%
	Non-body	Video	VP	185		28.91%	0	0.00%

5. Conclusions and Implication

In response to the question of how to understand the effectiveness of the college dance classroom teaching mode with technical support, the behavioral data of college dance classroom teaching reflects the behavioral laws and characteristics of the dance teaching process. Based on the perspective of behavioral sequence analysis, this paper explores the characteristics and laws of multimodal behaviors in college dance classrooms through the lag sequential analysis method and quantitative analysis of behavioral characteristics. It mainly explores the multimodal characteristics in college dance teaching; compares the behavioral state transfer law at different teaching stages in the teaching process; and the homogeneity and differences between traditional and multimodal modes. The study shows that multimodal classroom teaching in college dance includes pure verbal modality and non-verbal modality of the body as the main components of the classroom, and the modality is reasonably used, especially the modal synergy of simulation, intonation, formation, and video courseware achieves the expected goal of multimodal classroom teaching in dance, but the frequency of verbal modality of students' active questioning during the teacher's demonstration of the dance movement is relatively low, interpersonal interactions are enhanced when mediated by the teacher's questioning, instruction, and encouragement modes. The results of this study provide new ideas for further analysis of teachers' behavioral patterns of teaching and can provide key evidence of behavioral aspects for the development of dance teaching patterns in colleges and universities, thus promoting the process of technology application in dance classes. It should be mentioned that, because the number of video recordings of dance classroom teaching in domestic colleges and universities is still insufficient, researchers need to further enrich the teaching practice in the future, so as to provide more research samples for more researchers and obtain more sufficient evidence of practice.

Author Contributions

M.Z.: conceptualization, methodology, data curation, visualization, investigation, writing—original draft; F.C.: conceptualization, writing—original draft, writing—reviewing and editing; Y.M.: supervision, conceptualization, methodology, writing—reviewing and editing. All authors have read and agreed to the published version of the manuscript.

Funding

The research was funded by the Teaching Reform Project of Colleges in Guangdong Province (Grant number 2024-9-802), and the Guangdong Philosophy and Social Sciences Planning 2026 Youth Project "Intelligent Integration and Innovation Empowering Rural Aesthetic Education Classrooms: Evaluation Model and Evidence-Based Improvement Path for Effective Teaching Behaviors"(Grant number GD26YYS73), and the Macao Science and Technology Development Fund (FDCT) (Grant number 0071/2023/RIB3).

Institutional Review Board Statement

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board of the Faculty of Education, City University of Macau (protocol code SOE-09-03-2425-04-06-DEDCF, date of approval 10 January 2025).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declare no conflict of interest.

References

Cappello, N., Anttila, E., & Cañabate, D. (2024). Body as Classroom: Movement-based Performing Arts as an Approach to Embodied Transformative Learning in a Secondary School Classroom. *International Journal of Education and the Arts*, *25*, 20. https://doi.org/10.26209/IJEA25N20.

Cohn, C., Snyder, C., Fonteles, J. H., Ashwin, T. S., Montenegro, J., & Biswas, G. (2025). A multimodal approach to support teacher, researcher and AI collaboration in STEM + C learning environments. *British Journal of Educational Technology*, *56*(2), 595–620. https://doi.org/10.1111/bjet.13518.

Daher, R. (2025). Integrating AI literacy into teacher education: A critical perspective paper. *Discover Artificial Intelligence*, *5*(1), 217. https://doi.org/10.1007/s44163-025-00475-7.

De Las Heras-Fernández, R., Cuellar-Moreno, M. J., Espada Mateos, M., & Anguita Acero, J. M. (2025). The influence of teaching styles on the emotions of university students in dance lessons according to sex. *Research in Dance Education*, *26*(2), 182–201. https://doi.org/10.1080/14647893.2022.2144197.

Demian N.-C. (2024). A táncoktatás és a digitális technológia találkozásának vizsgálata. *Tánc és Nevelés*, *5*(1), 127–139. https://doi.org/10.46819/TN.5.1.127-139.

Ding, J. (2024). Deep learning perspective on the construction of SPOC teaching model of music and dance in colleges and universities. *Systems and Soft Computing*, *6*, 200137. https://doi.org/10.1016/j.sasc.2024.200137.

Fu, C., Xu, L., Fang, R., Wang, F., Wang, Y., & Hu, S. (2025). Balancing Empowerment and Discipline: A Study of the Normative Framework for the Use of Artificial Intelligence Tools by University Faculty and Students. *Journal of Educational Technology and Innovation*, *7*(4). https://doi.org/10.61414/74rkd239.

Huang, R., Zhang, L., & Li, Y. (2025). Transforming dance education in China: Enhancing sustainable development and cultural preservation. *Research in Dance Education*, 1–29. https://doi.org/10.1080/14647893.2025.2524151.

Lee, G.-G., Shi, L., Latif, E., Gao, Y., Bewersdorff, A., Nyaaba, M., Guo, S., Wu, Z., Liu, Z., Wang, H., Mai, G., Liu, T., & Zhai, X. (2023). *Multimodality of AI for Education: Towards Artificial General Intelligence*. arXiv. https://doi.org/10.48550/arXiv.2312.06037.

Li, J., & Ahmad, M. A. (2025). Evolution and trends in online dance instruction: A comprehensive literature analysis. *Frontiers in Education*, *10*, 1523766. https://doi.org/10.3389/feduc.2025.1523766.

Li, R., Cevikbas, M., & Kaiser, G. (2024). Mathematics teachers' beliefs about their roles in teaching mathematics: Orchestrating scaffolding in cooperative learning. *Educational Studies in Mathematics*, *117*(3), 357–377. https://doi.org/10.1007/s10649-024-10359-9.

McCabe, L. V., & Risner, D. (2025). Using Student Field Observations in Dance Pedagogy Coursework: Learner and Teacher Perspectives. *Journal of Dance Education*, *25*(1), 23–34. https://doi.org/10.1080/15290824.2023.2214558.

Moon, J., Yeo, S., Banihashem, S. K., & Noroozi, O. (2024). Using multimodal learning analytics as a formative assessment tool: Exploring collaborative dynamics in mathematics teacher education. *Journal of Computer Assisted Learning*, *40*(6), 2753–2771. https://doi.org/10.1111/jcal.13028.

Rahmanu, I. W. E. D., & Molnár, G. (2024). Multimodal immersion in English language learning in higher education: A systematic review. *Heliyon*, *10*(19), e38357. https://doi.org/10.1016/j.heliyon.2024.e38357.

Song, R., & Liu, S. (2024). The Effect of Dance Education on College Students' Artistic Quality Under the New Media: *International Journal of Web-Based Learning and Teaching Technologies*, *19*(1), 1–16. https://doi.org/10.4018/IJWLTT.337969.

Song, Y. (2024). Relocation and Cultivation of Teacher's Role by Digitalization of Dance Teaching. *The Educational Review, USA*, *8*(7), 973–978. https://doi.org/10.26855/er.2024.07.014.

The New London Group. (1996). A pedagogy of multiliteracies: Designing social futures. *Harvard Educational Review*, *66*(1), 60–92.

Wang, T., & Yu, X. (2024). Practical analysis of multi-modal teaching behavior in elementary school music singing game teaching. *Arts Educa*, *41*.

Wu, D., & Zhao, Q. (2024). Multimedia interactive creative dance choreography design integrating hybrid density network algorithms. *International Journal of Information and Communication Technology*, *24*(8), 39–51. https://doi.org/10.1504/IJICT.2024.139863.

Xu, J. (2023). *Study on Superimposed Teaching Mode of Mechanical Manufacturing Course—Take Shandong Engineering Vocational and Technical University as an example*. [Doctoral dissertation, SIAM University]. ProQuest Dissertations and Theses Global.

Yang, S., Su, B., & Yang, S. (2025). Toward an Integrated Framework for Understanding and Guiding Human-AI Collaboration in Secondary School EFL Teaching. *Journal of Educational Technology and Innovation*, *7*(4). https://doi.org/10.61414/y569v827.

Yin, Y. (2024). Analysis of the Current Status and Development Strategies of Dance Education in Vocational Colleges. *Journal of Modern Education and Culture*, *1*(2). https://doi.org/10.70767/jmec.v1i2.352.

Zhang, D. (2009). On a synthetic theoretical framework for multimodal discourse analysis. *Foreign Languages in China*, *6*(1), 24–30.

Zhang, J. (2024). The Practice of AI Technology Empowering the Reform of Higher Dance Education Management Research. *The Educational Review, USA*, *8*(8), 1097–1101. https://doi.org/10.26855/er.2024.08.014.

Zhang, Z., & Wang, W. (2024). Enhancing dance education through convolutional neural networks and blended learning. *PeerJ Computer Science*, *10*, e2342. https://doi.org/10.7717/peerj-cs.2342.

Zhou, C. (2025). Multimodal teachers behaviors in online music classes for Chinese primary and secondary schools: An analysis of six demonstration videos. *Cogent Education*, *12*(1), 2563700. https://doi.org/10.1080/2331186X.2025.2563700.

Zhou, L., Zhao, J., & He, J. (2024). A Diffusion Modeling-Based System for Teaching Dance to Digital Human. *Applied Sciences*, *14*(19), 9084. https://doi.org/10.3390/app14199084.