

DESIGN AND IMPLEMENTATION OF DANCESPORT VIDEO TEACHING SYSTEM BASED ON MODEL-VIEW-CONTROLLER (MVC)

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Abstract

Dancesport, a form of social dance that blends competition with artistry, serves as both a cultural enrichment activity and a fitness choice for many. Despite its benefits, traditional Dancesport instruction typically requires in-person classes, which can limit accessibility due to constraints of time and location. As a result, many enthusiasts miss out on fully experiencing the joy of dance. However, advancements in computer networks and communication technology have paved the way for online teaching to become a practical alternative. Addressing the specific needs of modern Dancesport education, this paper focuses on the development of a video teaching system using MVC architecture. By integrating technologies such as Freemarker templates, Hibernate frameworks, the MySQL 5.0 database, and Hadoop, the system is designed to enhance Dancesport learning. The project includes a comprehensive analysis of the functional requirements for the system, followed by an overall design plan. Key functional modules are thoroughly examined to ensure the system meets the unique demands of Dancesport instruction, providing an innovative solution for accessible and engaging dance education.

Keywords: Design; Dancesport video; Teaching system; Video teaching system; Dancesport education

Abstrak

Dancesport merupakan salah satu bentuk tari sosial yang memadukan kompetisi dengan seni, berfungsi sebagai aktivitas pengayaan budaya dan pilihan kebugaran bagi banyak orang. Meskipun bermanfaat, instruksi Dancesport tradisional biasanya memerlukan kelas tatap muka, yang dapat membatasi aksesibilitas karena keterbatasan waktu dan lokasi. Akibatnya, banyak penggemar tidak dapat sepenuhnya merasakan kegembiraan menari. Namun, kemajuan dalam jaringan komputer dan teknologi komunikasi telah membuka jalan bagi pengajaran daring untuk menjadi alternatif praktis.

Makalah ini berfokus pada pengembangan sistem pengajaran video menggunakan arsitektur MVC dengan membahas kebutuhan khusus pendidikan Dancesport modern. Dengan mengintegrasikan teknologi seperti templat Freemarker, kerangka kerja Hibernate, basis data MySQL 5.0, dan Hadoop, sistem ini dirancang untuk meningkatkan pembelajaran Dancesport. Proyek ini mencakup analisis komprehensif tentang persyaratan fungsional untuk sistem, diikuti oleh rencana desain keseluruhan. Modul fungsional utama diperiksa secara menyeluruh untuk memastikan sistem memenuhi tuntutan unik instruksi Dancesport dan memberikan solusi inovatif untuk pendidikan tari yang mudah diakses dan menarik.

Kata Kunci: Desain; Video dancesport; Sistem pengajaran; Sistem pengajaran video; Pendidikan dancesport

INTRODUCTION

Dancesport, also known as International Standard ballroom dance, is a unique combination of art and athletic competition, encompassing individual and partner-based performances. Dancesport falls into two broad categories. Standard dance is also called modern dance, and there are five kinds of dance: Waltz, Viennese waltz, Tango, Foxtrot, and Quickstep. Latin dance has five types: Rumba, Cha-cha-cha, Samba, Jive and Paso doble (Lavrentiev et al., 2023). Figure 1 shows the framework of the standard dance.



Fig 1. The framework of the standard dance
(source: Own documentation, 2025)

As a sport and cultural treasure, it promotes physical health, mental well-being, and artistic expression, making it highly valued in educational settings. Particularly in China, Dancesport has gained popularity over the past decade (Dai

et al., 2022), demonstrating its role in fostering physical fitness, emotional health, and cultural inheritance. Its inclusion in college and university curricula enhances students' physical and mental qualities, enriches their ideological connotations, and facilitates the inheritance of diverse cultural traditions. Countless Dancesport competitions are held annually in China and worldwide (Yu & Buck, 2024). It has evolved into a competitive sport that showcases high levels of artistry and skill (Duan et al., 2024). Throughout this process, the inheritance and development of international dancesport have also been actively promoted (X. Liu et al., 2023).

However, traditional teaching methods in Dancesport face significant challenges. These include time and space constraints that limit access for enthusiasts, outdated teaching patterns that fail to engage modern students, and a lack of Integration and innovation in curriculum content and instructional strategies. Traditional classroom teaching often emphasizes teacher-led instruction, which overlooks students' personalized needs and fails to exploit contemporary technologies. Furthermore, limited opportunities for practical application, an unscientific curriculum structure, and a scarcity of teaching and research initiatives further hinder the growth of Dancesport education. These challenges call for innovative solutions, such as modern multimedia tools and hierarchical teaching methods, to make Dancesport education more accessible, engaging, and effective.

A video teaching system is one of the multimedia solutions that can overcome challenges from the traditional learning methods mentioned above (Chen & Jiang, 2022). Specifically, it aims to improve students' learning process through a more engaging learning experience for modern learners (Fu et al., 2025). Video teaching system also breaks the space and time constraints of traditional classroom learning because it expands the learning time desired by enthusiasts (Y. Liu et al., 2022). Furthermore, it has a strong visual impact, so it is a suitable resource for presenting the content of dance education, thus conducive to students' understanding and retention of knowledge and technology (Tuyen, 2022).

Video teaching systems can attract students' attention quickly so that the learning impact obtained can be more remarkable (Riordan, 2022). This learning system supports the autonomous learning of students and dancers because it is more flexible and practical to watch and analyze (Y. Liu et al., 2022). On the other hand, teachers/instructors still have an important role because they build social

interactions with students, with both parties watching and discussing videos together at certain moments (Megawati & Trisnawati, 2022).

There are various forms of video teaching systems: live streaming video teaching (Zoom, Microsoft Teams, Google Meet), on-demand video teaching (Udemy, Coursera, Khan Academy) (Rafique et al., 2024), interactive video teaching (HSP Interactive videos, Edpuzzle) (Cesare et al., 2021), gamified video teaching (Duolingo, Codecademy) (Alptekin & Temmen, 2020), hybrid video teaching (blended learning platforms) (Flynn-Wilson & Reynolds, 2020), AI-driven video teaching (Scribesense), and video teaching with learning management system (LMS) integration (Moodle, Blackboard, Google Classroom) (Olatunde-Aiyedun et al., 2024). These various forms of video teaching systems require a framework to carry out the learning function from the main source in videos that replace traditional learning sources.

In this article, the author compares several existing frameworks and shows that MVC (Model-View-Controller) is the best and most important teaching system design framework for dancesports learning. In line with this, the next section will discuss various software design frameworks that are relevant to use in video teaching systems and show the advantages of MVC, along with its disadvantages, compared to other frameworks. After that, the discussion will focus on MVC technically by highlighting its specific features. After this discussion, an explanation regarding implementing MVC in dancesports learning is presented. The author also explains testing methods to ensure the functionality and performance of the MVC system. Finally, after the discussion, the author offers some insights into the next steps in developing and implementing MVC in the context of dancesports learning.

METHOD

The research adopted a developmental research design, guided by the principles of software engineering and instructional design. The approach was iterative, comprising analysis of needs, system design, prototyping, testing, and implementation. Emphasis was placed on applying the Model-View-Controller (MVC) software architecture due to its ability to modularize user interfaces, business logic, and data layers, thereby improving scalability and maintainability.

Data for system requirements were gathered using a mixed-method strategy, including document analysis, expert consultations, and user feedback. Document analysis performed on curriculum needs, Dancesport instructional

practices, and existing e-learning systems. Meanwhile, expert consultations performed with Dancesport instructors and IT developers to elicit functional and pedagogical needs. User feedback collected during pilot implementation via structured observation and semi-structured interviews at Nanjing Sport Institute.

The system was designed with Freemarker for dynamic HTML rendering (View), Hibernate for ORM-based database interaction (Model), MySQL 5.0 for structured data storage (user profiles, video metadata, performance logs), and Hadoop for distributed video file storage and real-time content delivery (Controller-Model interface). The modules were developed for secure user management with role-based access (admin/instructor/student), video uploading and categorization by dance type and skill level, annotation tools for video-based feedback, performance analytics dashboards, and device-responsive UI for inclusive access.

Analytical procedures includes functionality testing, performance evaluation, and user acceptance testing. Functionality testing was performed using black-box testing to ensure module interactivity and integration integrity. Meanwhile, performance evaluation included stress testing video streaming performance across multiple devices and bandwidths. User acceptance testing gathered insights from students and instructors through Likert-scale surveys and open-ended feedback to assess usability, learning support, and user satisfaction. All data from implementation and testing were analyzed descriptively and thematically to inform system refinements and validate the system's educational utility.

RESULT AND DISCUSSION

MVC framework and Video Teaching System

Conceptually, a video teaching system can be developed with various software architectures. The diversity of these architectures is shown in Table 1. Among these frameworks, MVC is suitable for a video teaching system to teach dancesports. Although other design patterns, such as MVVM or Event-Driven Architecture, have certain advantages, MVC is the best choice for Dancesport teaching system because it is simple, flexible, and suitable for data management and user interface in the context of learning videos.

Table 1. Variety of Software Architecture

Architecture	Advantages	Disadvantages
Model View Controller (MVC)	Facilitate unit maintenance and testing, separation of responsibilities	Initial complexity and overhead in development
Model View View Model (MVVM)	It supports a clearer separation between UI (User Interface) and business logic and allows data binding to update Views automatically.	It is more complex and requires in-depth understanding.
Model View Presenter (MVP)	Separating presentation logic from the Model makes it easier to perform unit testing.	Interaction management can be tricky.
Layered architecture	Simplifying modular development	Cross-layer dependencies are more difficult to manage
Microservices architecture	High fault tolerance, independent updates	Requires significant effort to manage services
Event-driven architecture	Enables a reactive decoupling system	Difficult to debug and ensure consistency

Source: (Magfira et al., 2024)

In the MVC framework, the design of an information system is organized into three distinct layers: the Model, view, and Controller. The Model handles information management and notifies observers whenever changes occur in the data. It is the only layer that contains data and the functions needed for data processing. The view is responsible for rendering graphics on a device, typically having a one-to-one relationship with a screen surface and knowing how to generate it. The Controller processes user input and directs the Model and view to perform actions accordingly. The separation between the Model and view enables multiple views to utilize the same Model (Subari et al., 2021).

This software design paradigm first organizes the code so that the code becomes a form of data, business logic, and interface display separated from each other. It aggregates the business logic together into a component. It then refines and implements the custom interface and user interaction without the business logic needing to be reworked. MVC has been uniquely developed to folder traditional input, process sing, and output functions in a logical graphic user interface structure. MVC originally existed in desktop programs. The purpose of using MVC is to separate the M and V implementation codes so that the same program can use different forms. For example, a batch of statistics data can be represented by histogram and pie chart,

respectively. C ensures synchronization between M and V. Once M changes, V should be updated synchronously.

MVC framework was chosen for the video teaching system because each component is separate, so developers can update the user interface (View) without changing the business logic (Model) or vice versa. The system can also be further developed, for example, by adding new features such as interactive quizzes or tracking student progress. Furthermore, an organized structure can expand the system to handle more users, materials, or functions. The View component enables a responsive and attractive user interface, while the Controller ensures smooth interactions.

Of the many video teaching systems available, several are relevant because they can overcome the time and space constraints of traditional dancesports teaching and provide a more structured and participatory learning experience. Interactive Video Teaching allows teachers to insert interactive elements into videos, such as quizzes or reflective questions, thereby increasing student participation. For dancesports, this feature can be used to ask students to identify technique errors or understand movement details. In this system, the Model is the database of student interactions and evaluation results, the view is the video interface with interactive elements (e.g., buttons for quizzes or simulations), and the Controller manages interaction logic by collecting answers and providing feedback.

Interactive video teaching systems such as H5P Interactive Videos and Edpuzzle prioritize student engagement by incorporating features like video playback with automatic pauses. These pauses present quizzes, questions, or additional explanations, allowing students to reflect on critical concepts during lessons. Annotation tools further empower instructors to highlight specific movements or postures directly on the video, ensuring learners grasp the nuances of dancesport techniques. Additionally, customizable feedback mechanisms allow personalized responses to student input, while gamified elements, such as awarding points or badges, foster motivation and active participation. For example, teachers could embed formative assessments within the content to hold students accountable for their learning (Carey et al., 2023).

On-demand video teaching is also relevant to dancesports teaching. This platform offers flexibility to students to learn anytime and anywhere. In the context of dancesports, prerecorded teaching videos can provide access to training materials appropriate to each student's ability level. In this system, the Model is the video data, quizzes, and student progress; the view is the learning portal with video navigation

features, and the Controller manages video access, progress storage, and student evaluation.

On-demand video teaching systems like Udemy and Coursera provide unparalleled flexibility, enabling students to learn at their own pace by pausing, rewinding, or fast-forwarding videos. These platforms offer prerecorded lectures and webinars that can be used for dance education (Beard & Konukman, 2020). Students can learn directly from world-class instructors (Sucharitakul et al., 2023). The resources provided by these platforms can enhance engagement and the dance learning experience (Deng & Gao, 2023). These platforms enhance understanding by offering supplementary resources, such as downloadable guides and choreography charts, complementing the video content. Certification tracking motivates students to complete their courses by rewarding them with badges or certificates. Moreover, discussion forums provide a collaborative environment where learners can exchange insights, clarify doubts, and engage with instructors, building community. On-demand video teaching systems can also be flipped classrooms where on-demand videos are shared with students with detailed instructions so that students can learn before the actual real-time learning time (Tsuchida et al., 2022). The quality of the videos produced must, of course, be adapted to the age of the students so that they can be interesting and meet the requested expectations (Hatfield et al., 2023).

Video Teaching with LMS Integration is a video learning system integrated with a learning management system. Integration with a learning management system allows dancesports teaching to be more organized. Teachers can upload practice videos, provide feedback, track student progress, and manage evaluations efficiently. The Model in this system is course content, schedule, and student data; the view is the LMS portal with integrated video, and the Controller manages video synchronization with LMS features.

Video teaching systems integrated with learning management systems (LMS), such as Moodle and Blackboard, offer a comprehensive approach to dancesport education. These systems track student performance, monitor completed lessons and quiz scores, and even upload practice videos. Integrated feedback mechanisms enable instructors to provide detailed, actionable corrections on student submissions, often using video annotation tools to mark areas of improvement visually. With features like interactive scheduling, students are guided through a structured training regimen, while Integration with external tools (e.g., Zoom) facilitates hybrid learning by combining live instruction with asynchronous resources. In addition, LMS-integrated video learning systems enable teachers to experience social, instructional,

and cognitive presence in blended learning through synchronous and asynchronous dialogue with colleagues (Nguyễn et al., 2022). Educational institutions can use these systems to manage resource sharing and classroom management so that the platform is accessible to the school community and familiar with it (O'Brien, 2023).

Functional Requirements of the Dancesport Video Teaching System

The Dancesport Video Teaching System is designed with a comprehensive set of functional requirements to meet the unique demands of Dancesport education. These features are tailored to support learners and instructors through secure management, interactive tools, and efficient workflows. Streamlined tools for uploading and managing video content save instructors time and effort, enabling them to focus on teaching instead of technical challenges.

First, to ensure secure access, the system provides robust user authentication, allowing users to register, log in, and access role-based features based on whether they are administrators, instructors, or learners, achieved through the Integration of a strong authentication module, supported by MySQL 5.0 and Hibernate for seamless and secure management of user roles.

Next, organizing instructional videos by dance type, skill level, and instructor is critical for effective teaching. The system supports uploading, categorizing, and managing these resources through a video management module powered by Hadoop, which ensures scalable and efficient storage and retrieval of video content. The categorized video library and personalized recommendations ensure learners access instructional material suited to their specific skill levels and dance styles, meeting the diverse needs of Dancesport education. The system supports large-scale video content delivery using Hadoop's distributed storage capabilities, ensuring consistent performance even during peak usage.

The system incorporates annotation tools that allow instructors to highlight key dance techniques and enable learners to take notes during video playback. Using Freemarker templates, the system delivers user-friendly annotation interfaces fully integrated with video playback functionality. By integrating annotation tools and interactive feedback mechanisms, the system enhances engagement, making it easier to master the intricate techniques of Dancesport.

The system also tracks learners' progress and provides insights through analytics dashboards. It also facilitates interactive feedback mechanisms such as quizzes and assessments. Learner performance data is stored in MySQL, with dynamic visualizations generated using Freemarker, ensuring real-time progress

monitoring. Analytics dashboards allow instructors to track learner progress and offer targeted feedback, helping to create effective improvement plans tailored to each learner's needs. Learners can efficiently locate relevant videos using keyword searches and benefit from personalized recommendations. These features are powered by Hadoop, which processes user activity data to generate tailored results and suggestions, enhancing the learning experience.

Accessibility across various devices, including PCs, tablets, and smartphones, ensures inclusivity. The MVC framework facilitates a responsive design, while Freemarker and controller logic adapt the layout to different screen sizes for seamless user experiences. Multi-device compatibility and intuitive interfaces make the system accessible to a wide audience, including users with limited technical skills, ensuring no one is left behind in the learning process.

The Design of Dancesport Video Teaching System

The Dancesport video teaching system uses the MVC (Model-View-Controller) framework to separate concerns and enhance maintainability. The Model handles data processing and database interaction, the view manages user interfaces and presentation, while the Controller processes user input and coordinates between the Model and view. This structure allows flexibility and scalability, making the system suitable for the dynamic requirements of Dancesport education.

Key technologies used in the design include Freemarker, Hibernate, MySQL 5.0, and Hadoop. Freemarker is a template engine. This template engine is employed in the view layer to generate web pages dynamically. It ensures that the graphical presentation of video tutorials, performance metrics, and feedback forms is engaging and user-friendly. Meanwhile, hibernate is used as the ORM (Object-Relational Mapping) framework to facilitate seamless interaction between the application and the database. It abstracts complex SQL queries, allowing for efficient data retrieval and management, such as video metadata, user progress, and annotations.

The system utilizes the MySQL 5.0 database to store all essential data, including user profiles, instructional video libraries, performance tracking records, and feedback logs. MySQL ensures robust and reliable data storage while supporting concurrent access. Hadoop technology is integrated for distributed storage and processing. It allows for efficient management of video files, ensuring smooth playback and fast access, even under high user demand.

The Dancesport video teaching system features video playback and annotation tools and high-quality video streaming with adaptive bitrate to accommodate varying

internet speeds. Annotation tools enable instructors and learners to add real-time video annotations, highlighting specific dance techniques or movements. Interactive feedback mechanisms include features like quizzes, polls, and interactive Q&A to enhance engagement. Performance tracking also tracks user progress through the lessons and evaluates learning outcomes with metrics and visual dashboards. A smart search engine powered by Hadoop allows users to find videos by dance type, level, or instructor. Personalized recommendations based on user behaviour further enrich the learning experience.

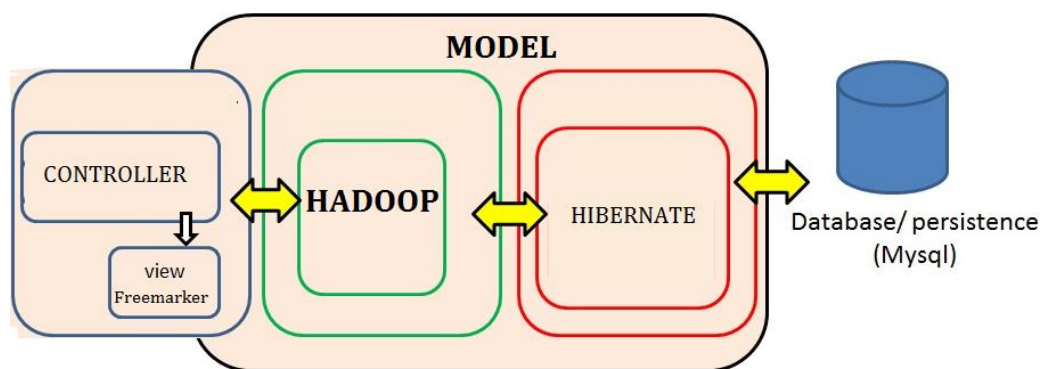


Fig 2. Architecture Diagram of the Dancesports video teaching system
(Source: Nandong, 2016)

Fig 2 shows a diagram of the designed system architecture. Freemarker technology is the driving force behind dynamic user interface rendering at the View layer. This template engine generates HTML or other formats to deliver an interactive and visually engaging learning experience. By separating the presentation logic from business logic, Free marker ensures that updates to the user interface are straightforward and do not disrupt the system's core functionalities.

In the Model layer, hibernate technology takes on the critical task of managing database interactions. Situated in the infrastructure sub-layer, hibernate serves as an Object-Relational Mapping (ORM) framework, simplifying the complexity of SQL queries and enabling seamless data retrieval, updates, and storage. It directly maps Java objects to the MySQL database, fostering a robust and efficient connection between the application and its underlying data. The MySQL 5.0 database is central to the Model's infrastructure sub-layer, functioning as the primary repository for structured data. User profiles, video metadata, analytics, and progress-tracking information are securely stored and efficiently managed within this relational database, forming the backbone of the system's data architecture.

Hadoop technology is integrated into the Model layer, spanning both the application and infrastructure sub-layers to handle the vast amount of video content and ensure uninterrupted service during high-demand periods. Hadoop organizes and processes large-scale video files within the application sub-layer, enabling swift retrieval and playback. Meanwhile, its infrastructure sub-layer capabilities provide distributed storage and computing power, ensuring the system remains scalable and resilient, even as user numbers and content volumes grow.

The Implementation of Dancesport Video Teaching System

The Dancesport Video Teaching System is implemented at the Nanjing Sport Institute. The teaching objectives, content, and mode are specifically adapted for this system to ensure an effective learning process. The implementation involves a structured approach where video resources are integrated into the curriculum to enhance both theoretical understanding and practical skills. Regular assessments are conducted to evaluate the effectiveness of the video teaching method in improving students' performance and engagement. Feedback from instructors and students is continuously collected to refine the system further and address any challenges that arise during its use.



Fig 3. The Dancesport video teaching system based on MVC
(Source: Battery Dance, 2021)

Discussion

The role of technology in dancesport education has so far had a moderate impact. Limited access in rural areas, financial constraints, a lack of technical expertise, language barriers, and challenges in addressing competitiveness-related

limitations are notable obstacles. Additionally, resistance to change among athletes poses a significant challenge (Huang, 2024). The development of learning technology using the MVC framework allows for the early introduction of technology to students to gain greater benefits from technology in supporting their dancesport performance.

The advantages MVC provides in developing dancesport education are its modular and extensible characteristics (Salim et al., 2024). These characteristics allow the video teaching system to be configurable, allowing various functionality configurations to support the context, curriculum, and goals of dancesport education. The MVC elements work together to deliver a well-structured, scalable, and user-centric Dancesport video teaching system, meeting the educational demands of both learners and instructors effectively.

While MVC provides a robust framework for developing modular, scalable, and maintainable teaching systems, it has challenges. Managing multiple components and ensuring seamless Integration can be daunting, especially in large-scale systems. However, adopting microservices architecture alongside MVC can mitigate these challenges by offering enhanced modularization and autonomy of components, thus paving the way for more efficient and sustainable development practices in educational technology (Bataineh et al., 2024).

CONCLUSIONS

Dancesport is a kind of international social activity dance. It plays an important role in enriching human life and improving human self-cultivation. However, traditional dance teaching is limited by time and space, so most enthusiasts are not satisfied. With the continuous development and maturity of computer networks and communication technology, online teaching has become a reality. Teaching can make up for the limitations of traditional Dancesport teaching, make people happy to study Dancesport at a designated time and place and achieve the purpose of improving the interest of dance lovers and improving the efficiency of dance teaching. Dancesport video teaching system is a combination of Dancesport and computer technology.

The designed system meets dancesport teaching needs. Dancesport teaching demands tailored content for varying skill levels and diverse dance styles. The system features a categorized video library and personalized recommendations, ensuring learners can access material suited to their needs. The incorporation of annotation tools and interactive feedback mechanisms

transforms the learning process into an engaging experience, enabling students to master the intricate movements required in Dancesport. The system's scalable and reliable infrastructure, powered by Hadoop's distributed storage capabilities, guarantees seamless access to large-scale video content, even during peak user activity. For instructors, performance monitoring becomes effortless with analytics dashboards that track learners' progress, offering insights to deliver targeted feedback and structured improvement plans.

Accessibility and inclusivity remain at the forefront, with multi-device compatibility and intuitive user interfaces designed to cater to a broad audience, including those with minimal technical expertise. Furthermore, instructors benefit from streamlined workflows as tools for uploading and managing video content, minimizing administrative burdens and allowing them to dedicate more time to teaching and mentoring.

Through the designed system, the content of dance teaching can be better displayed so that learners can learn and appreciate it. In this paper, through the application of the dancesport video teaching system, dance teaching can be more true and clear description, so enable students to learn by themselves. The video teaching system solves the time and space constraints in the process of dancesport teaching but also reproduces and decomposes the teaching process. It also provides an objective base for video teaching development and a platform for teachers and students to learn Dancesport.

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