Curriculum and Teaching Methodology (2025)
Clausius Scientific Press, Canada

DOI: 10.23977/curtm.2025.080324
ISSN 2616-2261 Vol. 8 Num. 3

Digital transformation of physical education teaching in higher education based on the OMO framework

Huijian Deng[1], Yige Tao[2]

[1]Physical Education Department, Chongqing University of Technology, Chongqing, 400054, China
[2]Xiamen University, Xiamen, 361005, China

Keywords: Digital transformation; physical education; OMO model

Abstract: This study explores the digital transformation of physical education (PE) teaching in higher education through the integration of the Online-Merge-Offline (OMO) teaching model. Recognizing the limitations of traditional PE methods, which often overlook interactive and practical elements, this research employs social network analysis to investigate the impact of OMO on student interaction and learning outcomes. Eighty sophomore students from two badminton elective classes at Chongqing University of Technology participated in this quasi-experimental study, which compared an experimental group using the OMO model with a control group following traditional teaching methods. The OMO model combines online pre-class learning, in-class tactical practice, and post-class reflection. Results indicate that the OMO model significantly enhances classroom interaction, student engagement, and skill acquisition compared to traditional methods. The study's findings align with communicative teaching theory and group socialization theory, highlighting the importance of multidimensional interaction in fostering effective learning environments. The experimental group exhibited higher levels of classroom participation, interaction frequency, and skill improvement, demonstrating the OMO model's potential to bridge the gap between online and offline learning contexts. These results provide valuable insights for PE educators seeking to implement digital teaching strategies and suggest that the OMO model can be effectively applied across various sports disciplines. However, the study acknowledges limitations such as a small sample size and a focus on short-term effects. Future research should consider expanding the sample and duration to further validate the OMO model's efficacy and explore its long-term impact on students' learning motivation and sports skills development.

1. Introduction

The report of the 20th Party Congress clearly articulated the need to accelerate the construction of a strong sports nation and established the promotion of the Healthy China strategy as a significant objective. Concurrently, the digital transformation of education has emerged as a new direction and a strategic advantage for the development of education in China. During the fifth collective study session of the Political Bureau of the Central Committee of the Communist Party of China, the leadership emphasized that digitalization is a critical path to enhancing education quality, thereby laying a policy foundation and setting the course for the digital transformation of physical

education (PE) teaching in colleges and universities. According to 2022 data, investment in informatization for primary and secondary education in China has reached 177.6 billion yuan, with no less than 8% of the annual education budget allocated to informatization construction.

However, the digitalization of PE teaching often encounters pitfalls, such as an over-reliance on "platform equipment," "theoretical data," and "information technology," while neglecting essential elements like "practical operation," "interactive communication," and the concept of "physical education as a holistic development of the individual." This overemphasis on technology at the expense of pedagogical goals leads to a diminished focus on the physical, creative, and interactive aspects of PE teaching. As a unique educational form, university PE teaching requires not only the support of information technology but also the development of theories and guiding principles tailored to its specific characteristics.

Although existing research on educational informatization and digital transformation has yielded some positive outcomes—such as the work done by Tsinghua University and Beijing Sport University in the construction of virtual teaching and research platforms and multi-level digital resources—these studies primarily focus on resource platform development and digital teaching methodologies. They often overlook the importance of interaction and the student experience in the teaching process.

In recent years, scholars such as Chen Lin, Yang Changxue (1997), and Huang Ronghuai (2009) have advocated for the integration of the OMO (Online-Merge-Offline) model, which combines the strengths of online and offline teaching to enhance students' sports experience and classroom engagement[1,2]. This model is expected to address the limitations of traditional PE classrooms in terms of time and space constraints and improve overall teaching effectiveness. However, effectively applying the OMO model to enhance interaction and teaching outcomes in PE remains a pressing challenge.

This study employs social network analysis to comprehensively describe the network structure of teacher-student interaction and communication. It quantitatively analyzes various types of relationships and captures the processes of information dissemination and interaction within teacher-student relationships. This approach provides new insights into the application of the OMO model in the digital transformation of PE teaching. Social network analysis has already demonstrated significant value in fields such as adolescent development interventions, academic achievement, and behavioral dynamics. Emirbayer and Goodwin (1994) noted that this method explains behaviors by examining patterns of relationships rather than individual attributes[3]. Scott (2012) and Tabassum et al. (2018) further elaborated on its application in adolescent developmental interventions[4,5].

Theoretically, this study enriches the framework of PE teaching informatization and offers new perspectives and models for the digital transformation of university PE instruction. Practically, it provides innovative teaching strategies and methods for university PE teachers, helping to improve the flexibility, diversity, and intelligence of PE teaching. For students, the new teaching model offers a more engaging learning and interaction platform, fostering greater motivation and interest in participating in sports informatization teaching. Additionally, this study provides university sports administrators with new data and metrics to monitor and assess the progress and outcomes of sports digital transformation, contributing valuable practical experience for the high-quality advancement of PE teaching reform in universities.

2. Research Design

2.1 Research Questions and Hypotheses

Research Questions:

RQ1: How does the OMO (Online-Merge-Offline) teaching model affect students' interaction patterns, learning outcomes, and class participation in a badminton elective course?

RQ2: How does the interaction network structure within an OMO-based badminton class influence the improvement of students' motor skills?

RQ3: Is the OMO teaching model more effective than traditional teaching methods in enhancing students' learning motivation and skill acquisition?

Research Hypotheses:

H1: The OMO teaching model significantly enhances students' class participation and learning motivation in the badminton elective course.

H2: Core interaction nodes within the classroom (e.g., actively participating students) significantly influence other students' learning outcomes.

H3: Compared to the traditional teaching model, the OMO model more effectively improves students' badminton skills and overall learning experience.

Participants

Sample Selection:

The participants were 80 sophomore students enrolled in two badminton elective classes at Chongqing University of Technology, with 40 students in each class.

2.2 Sample Characteristics

All participants were non-sports major students with basic badminton skills. Variables such as gender, age, and previous badminton learning experience were controlled in the analysis to minimize confounding effects.

2.3 Theoretical Framework

2.3.1 Theoretical Basis

(1) **Communicative Teaching Theory** This theory examines the impact of teacher-student and student-student interactions on teaching effectiveness by analyzing classroom interaction behaviors.

(2) **Group Socialization Theory** This theory explores the social relationships formed during the badminton elective course and their impact on motor skill development and learning attitudes.

(3) **Humanistic Education Theory** The researcher focuses on a student-centered approach to learning, emphasizing experience and interaction to construct an OMO teaching model that fosters students' interest and motivation (Smith,2021)[6].

2.3.2 Research Perspective

Social Network Analysis Perspective: This perspective examines the interaction network structure among students and its impact on learning outcomes, identifying core nodes and key interaction patterns in the classroom.

2.4 Experimental Design

Type of Experimental Design

Quasi-experimental design: An experimental group and a control group are established to compare the teaching effects of the OMO teaching model and the traditional teaching model.

2.4.1 Experimental Group and Control Group Setup

Experimental Group (OMO Teaching Model): The experimental group (OMO teaching model) combines online learning and offline practice, including pre-class online video learning and discussions, in-class tactical practice and interactive exercises, and post-class online reflection and knowledge consolidation.

Control Group (Traditional Teaching Model): The control group uses only the offline teaching model, where the teacher provides explanations and demonstrations, and students practice individually without online learning tasks or post-class reflection activities.

2.4.2 Experimental Procedure

(1) Pre-Test Phase

Skill Test: The teacher assesses students' badminton skills, including the accuracy and fluency of basic techniques such as serving, receiving, and footwork.

Learning Motivation Survey: The researcher uses a questionnaire to measure students' interest in badminton, motivation, and acceptance of digital teaching.

Social Network Survey: The researcher collects data on students' interaction relationships, including interaction frequency, depth, and types of content exchanged.

(2) Intervention Phase

Experimental Group

Online Module: The teacher assigns weekly video learning tasks related to badminton tactics (e.g., footwork, technical points). Students are required to watch the videos and participate in discussions or pose questions in the online forum.

Offline Module: The researcher conducts tactical training and group practice sessions in class, with teachers guiding students in interactive learning and cooperative practice.

Post-Class Reflection: Students submit weekly learning reflections and self-evaluation forms through an online platform, summarizing their classroom learning experiences and areas for improvement.

Control Group

Offline Teaching: The teacher provides tactical explanations and demonstrations. Students complete individual or group practice within the designated time, without fixed interaction or reflection components.

(3) Post-Test Phase

Skill Retest: The teacher reassesses students' badminton skills to compare skill improvements between the experimental and control groups after the intervention.

Learning Outcomes Survey: The researcher measures students' satisfaction, interest, and motivation changes regarding the OMO teaching model through a questionnaire.

Social Network Resurvey: The researcher collects post-intervention social network data to analyze the impact of the OMO model on students' interaction patterns.

(4) Follow-Up Phase

Interaction Data Analysis: The researcher uses social network analysis to study changes in student interaction in the classroom after the intervention, focusing on the impact of core node students on overall learning outcomes.

Teaching Reflection and Improvement: The researcher conducts in-depth interviews with students and teachers to gather feedback on the OMO model's implementation, identifying challenges and suggesting improvements.

2.5 Data Collection

2.5.1 Data Types and Collection Tools

(1) **Skill Test Data:** The teacher uses standardized badminton skill test forms (e.g., serve accuracy, return time, footwork flexibility).

(2) **Engagement Data:** The teacher Collected through five core indicators: attendance rate, class participation frequency, interaction frequency, homework completion rate, and learning engagement. Data collection tools include attendance records, classroom observation forms, homework statistics, real-time classroom records, and periodic surveys.

(3) **Social Network Data:** The researcher collected using a Name Generator questionnaire to obtain data on interaction frequency and content among students.

(4) **Teaching Logs and Reflection Reports:** The researcher collects online learning logs and reflection reports from experimental group students to analyze their acceptance of the OMO teaching model and learning outcomes.

2.5.2 Data Analysis Methods

(1) Statistical Analysis

The researcher uses SPSS for descriptive statistics, correlation analysis, and t-tests to compare differences in skill improvement, learning motivation, and class participation between the experimental and control groups. Conducts factor analysis on the questionnaire data to extract key factors influencing students' perceptions of the OMO teaching model.

(2) Social Network Analysis

The researcher utilizes UCINET and NETDRAW software to visualize the interaction networks among students, analyzing the impact of the OMO model on students' social relationships and learning outcomes. Calculates network centrality, density, clustering coefficients, and other indicators to identify key nodes (e.g., actively participating students) and their impact on teaching effectiveness.

2.6 Research Ethics

All participants signed informed consent forms to ensure voluntary participation and data privacy protection. No personal identity information was disclosed in data processing and presentation, and all data were used solely for academic research purposes.

3. Results

3.1 Classroom Interaction Analysis

Figure 1 shows the classroom interaction network structures of the experimental and control groups. It can be seen that the interaction network of the experimental group is denser, indicating more communication and interaction among students, while the network of the control group is relatively sparse, with less interaction among students.

Table 1 shows that the degree centrality, closeness centrality, and betweenness centrality of the students in the experimental group are significantly higher than those in the control group, indicating more frequent interactions and a more active classroom atmosphere in the experimental group.

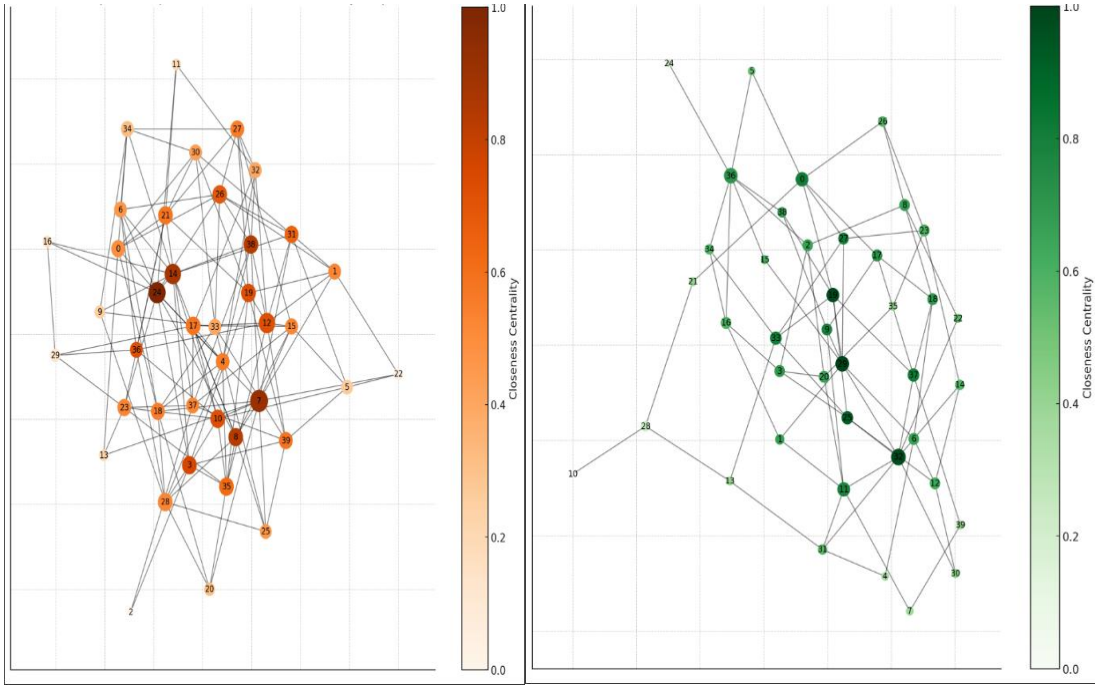

Figure 1: Classroom Interaction Networks of the Experimental and Control Groups

Table 1 Comparison of Interaction Network Centrality between the Experimental and Control Groups

Group	Degree Centrality	Closeness Centrality	Betweenness Centrality	Network Density
Experimental	0.75	0.68	0.45	0.15
Control	0.53	0.45	0.30	0.1

3.2 Student Engagement Analysis

Table.2 shows that the Experimental Group outperforms the Control Group in all classroom participation indicators, including higher attendance rate, more frequent participation and interaction, higher assignment completion rate, and greater engagement level, indicating a more active and engaged learning environment in the Experimental Group.

Table 2 Comparison of Classroom Participation between the Experimental and Control Groups

Participation Indicators	Experimental Group	Control Group
Attendance Rate	90	85
Participation Frequency	8	4
Interaction Frequency	15	7
Assignment Completion	95	80
Engagement Level	8.5	6

3.3 Learning Outcomes Analysis

Table 3 shows that the badminton skill levels of students in the experimental group improved significantly after the intervention, with an average increase of 25.2 points, while the control group showed only an 8.8-point increase. The significance analysis of the data from both groups indicates that the skill improvement in the experimental group was more pronounced following the teaching

intervention.

Table 3: Pre-Test and Post-Test Comparison of Badminton Skills between the Experimental and Control Groups

Group	Pre-test Mean	Post-test Mean	Score Difference	Significance
Experimental	60.2	85.4	25.2	$p < 0.01$
Control	61.5	70.3	8.8	$p = 0.03$

4. Discussion

4.1 Interpretation of Findings

This study examines the practical impact of the Online-Merge-Offline (OMO) teaching model on physical education in higher education by integrating theoretical frameworks with experimental results. The social network analysis indicates that the interaction network structure in the experimental group was denser, with significantly higher degree centrality and closeness centrality compared to the control group. These findings suggest that the OMO model effectively fosters student interaction and collaboration, particularly by integrating learning tasks with practical activities. The combination of online and offline elements enables students to engage more actively, which is consistent with the communicative teaching theory, emphasizing that effective interaction enhances learning outcomes and improves the classroom atmosphere.

Furthermore, the experimental group demonstrated significantly higher levels of student engagement than the control group, reflecting the OMO teaching model's effectiveness in motivating student interest and participation. The seamless integration of online learning tasks with offline practical activities allows students to maintain high engagement across various learning contexts. This result aligns with the principles of humanistic education theory, which advocates a "student-centered" approach, aiming to enhance educational outcomes by promoting student initiative and participation.

Regarding learning outcomes, the results show a significant improvement in the badminton skills of students in the experimental group, surpassing those in the control group. This indicates that the OMO model, through flexible teaching designs and diverse learning activities, aids students in better mastering and applying their skills. This finding supports group socialization theory, which posits that multidimensional interaction and collaboration enable students to adapt more effectively to new learning tasks and requirements.

4.2 Comparison with Existing Research

This study's findings are compared with existing research to analyze similarities, differences, and potential reasons for these variations. In terms of interaction structure, the OMO model in this study significantly enhanced the density and depth of classroom interactions compared to the findings of Yin Hai et al. (2021) on classroom interaction in physical education[7]. This improvement may be attributed to increased collaboration and discussion among students during online tasks, fostering a more cohesive interaction network in the offline classroom.

In terms of learning outcomes, the OMO model was found to more effectively enhance students' motor skills compared to the digital teaching models studied by Li et al. (2021)[8]. This improvement is closely related to the experimental group's active participation in post-class reflection and online learning, indicating that the OMO model not only enhances classroom teaching effectiveness but also provides students with more opportunities for autonomous learning and reflection.

Moreover, when compared to traditional teaching models, such as those explored by Zhao Huayu (2021), this study observed higher levels of student engagement and enthusiasm in the experimental group[9]. This increased engagement may be due to the OMO model's provision of richer learning resources and diverse forms of interaction, which stimulate students' learning motivation and interest.

4.3 Practical Implications

The findings of this study have significant practical implications for physical education in higher education, providing robust evidence to support the adoption of the OMO teaching model in sports education. First, the OMO model significantly improves the quality of classroom interactions and student engagement, offering valuable insights for designing physical education courses in higher education. Educators can integrate online resources with offline activities to facilitate student interaction across different learning environments, thereby enhancing classroom engagement and interactivity.

Moreover, the application of the OMO model in badminton instruction suggests that educators can utilize online learning platforms and resources for pre-class preparation and post-class reflection, reserving in-class time for skill development and personalized feedback. This approach not only increases classroom efficiency but also better addresses the diverse learning needs of students. Additionally, the successful implementation of the OMO model in this study highlights its potential application in various sports, such as basketball and soccer, by combining online learning tasks with offline practice to enhance both students' sports skills and their interest in learning.

4.4 Limitations and Future Research Directions

This study has several limitations that should be addressed in future research. First, the relatively small sample size, focused on a badminton elective course at Chongqing University of Technology, may limit the generalizability of the findings. Future research could expand the sample size to include multiple institutions and a variety of sports to validate the effectiveness of the OMO model in a broader range of teaching contexts.

Additionally, this study primarily examined the short-term effects of the OMO teaching interventions, without analyzing the long-term impacts of this model. Future research should consider extending the experimental period to assess the long-term influence of the OMO model on students' sports skills and learning motivation. Finally, the current study evaluated the OMO model's teaching effectiveness mainly through classroom interaction and learning outcomes. Future studies could incorporate additional dimensions, such as students' emotional development and self-efficacy, to provide a more comprehensive evaluation of the educational impact of the OMO model.

Acknowledgement

The research is supported by: Chongqing Higher Education Association: "Research and Practice on the Digital Transformation of Physical Education Teaching in Higher Education Based on OMO High-Quality Promotion"(cqgj23083C)

References

[1] Chen, L., Yang, G., & Huang, R. (1997). The essence and connotation of digital teaching. Journal of Educational Technology, 8(1), 15-19.

[2] Huang, R. (2009). Digital teaching models and their application in physical education. Educational Information

Technology, 30(12), 23-27.
[3] Emirbayer, M., & Goodwin, J. (1994). Network analysis, culture, and the problem of agency. American Journal of Sociology, 99(6), 1411-1454.
[4] Scott, J. (2012). What is social network analysis? Bloomsbury Academic.
[5] Tabassum, S., Pereira, F. S. F., & Fernandes, S. (2018). Social network analysis: An overview. Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery, 8(5), e1256.
[6] Smith, J. (2021). Humanistic Education: A Student-Centered Approach. Journal of Educational Theory, 45(3), 123-135.
[7] Yin, H., Cao, Y., & Wang, W. (2021). Design and application of the hybrid teaching mode of school physical education based on Rain Classroom. Theory and Practice of Education, 41(36), 61-64.
[8] Li, Y., & Yu, Z. (2021). Research on the strategy and countermeasures for the digital development of physical education teaching in universities. Sports Technology, 42(5), 55-60.
[9] Zhao, H. (2021). Exploration of multi-level physical education teaching in universities based on information technology. Chinese School Health, 42(2), 1.