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Article

Optimizing NASM-OPT training in hybrid cheerleading education: A biomechanical approach

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Abstract: This study explores the optimization of the NASM-OPT (National Academy of Sports Medicine–Optimum Performance Training) model in cheerleading education, integrating a biomechanical approach to enhance student performance in both physical and technical aspects. The increasing prominence of hybrid teaching models in sports education—combining offline and online components—has been acknowledged as a key strategy to improve student engagement and learning outcomes. Aimed at addressing the physical demands of cheerleading, the NASM-OPT training model was adapted to the specific needs of cheerleading students, with a focus on biomechanical efficiency, injury prevention, and performance enhancement. The study, conducted at Tianjin Sino-German University of Applied Sciences, involved a 12-week intervention, where the experimental group received NASM-OPT training while the control group followed traditional methods. Results showed significant improvements in physical fitness indicators such as strength, flexibility, and coordination, all crucial for effective cheerleading performance. Furthermore, the biomechanical aspects of the NASM-OPT model contributed to better posture, technique, and overall athleticism, which are essential in this dynamic sport. By incorporating biomechanical principles into the training regimen, the optimized NASM-OPT model not only fostered improved physical outcomes but also enhanced students' psychological and motivational states, contributing to greater learning satisfaction and achievement. This research demonstrates the potential of integrating biomechanical optimization within hybrid teaching environments to maximize both the educational and athletic development of students in cheerleading.

Keywords: NASM-OPT; cheerleading education; hybrid teaching; biomechanical optimization; performance enhancement; sports psychology; physical fitness; educational software

1. Introduction

In recent years, sports education has undergone significant transformation, driven by the increasing adoption of digital tools and hybrid learning methods. Educational institutions worldwide are leveraging technological advancements to integrate online and offline learning, with cheerleading emerging as a sport of interest due to its unique combination of athleticism, coordination, and artistry. Globally, cheerleading has witnessed remarkable growth, transitioning from a performance-oriented activity to a competitive discipline recognized by organizations such as the International Cheer Union (ICU) and being provisionally recognized by the International Olympic Committee (IOC) [1,2]. In regions such as North America, Europe, and Asia, cheerleading has evolved into a structured sport with standardized rules, competitions, and training programs, further cementing its role in educational institutions and professional leagues. Particularly in China, cheerleading's rising popularity in schools and universities reflects its growing appeal as a sport that combines physical skill, teamwork, and creativity.

Cheerleading requires a complex integration of strength, flexibility, coordination, and aerobic endurance. Its intricate movements, including lifts, stunts, and jumps, place substantial biomechanical demands on participants, necessitating training approaches that enhance performance while minimizing injury risks. Biomechanics, the study of the mechanics of body movements, plays a crucial role in addressing these demands by analyzing forces and motions to improve movement efficiency and reduce the risk of injuries [3,4]. In various sports such as gymnastics, track and field, and swimming, biomechanical analysis has been instrumental in refining techniques, optimizing training regimens, and preventing injuries. For example, in gymnastics, biomechanical studies have helped improve the execution of vaults and landings, while in swimming, analyses of stroke mechanics have enhanced speed and efficiency. These cases underscore the importance of biomechanics in sports performance, highlighting its potential to address the specific demands of cheerleading.

The NASM-OPT (National Academy of Sports Medicine–Optimum Performance Training) model, widely used in athletic training, offers a systematic and progressive framework for improving physical performance through stabilization, strength, and power phases. Its application in cheerleading training holds promise, particularly when adapted to address the sport's unique biomechanical requirements, such as high-intensity movements, rapid direction changes, and precise body control [5,6]. By integrating biomechanical principles, this study aims to enhance the NASM-OPT model for cheerleading, enabling the design of personalized training programs that improve movement efficiency, muscle coordination, and injury prevention.

The hybrid teaching model further complements this approach, combining online theoretical instruction with supervised in-person training sessions. This format offers students greater flexibility to access and review educational content while allowing for real-time feedback and practical application of biomechanical principles during physical training. Such integration not only supports the physical and technical development of cheerleaders but also fosters deeper learning and engagement [7].

This study, conducted at Tianjin Sino-German University of Applied Sciences, explores the optimization of the NASM-OPT model through a biomechanical lens within a hybrid cheerleading education framework. A controlled experiment was carried out with two groups of students: one following traditional training methods and the other utilizing the biomechanically optimized NASM-OPT model. The primary objective is to examine the effects of this approach on physical fitness, technical performance, and overall training satisfaction. By drawing on global trends in cheerleading and leveraging biomechanical insights, this research contributes to the development of more effective, safe, and personalized training methods, offering a model for future advancements in sports education.

2. NASM-OPT training model optimizations: A biomechanical approach

The NASM-OPT model is a comprehensive, integrated training system designed to optimize sports performance by focusing on functional movement patterns. This training model emphasizes a progressive and structured approach to enhance physical performance across multiple fitness domains, such as stability, strength, power, and endurance. The system is based on the principle of functional training, which integrates various movement patterns that mimic the dynamic and multidimensional actions required in sports [8,9].

In the context of cheerleading, the NASM-OPT model is particularly valuable due to the sport's complex movements that require a combination of strength, flexibility, coordination, and explosive power. Cheerleading routines involve dynamic actions such as jumps, lifts, stunts, and rapid changes in body position, all of which place significant biomechanical demands on the body. By optimizing training through the NASM-OPT model, it is possible to enhance the biomechanical efficiency of these movements, improving athletic performance while reducing the risk of injury.

Assuming a limited sample data set $X = \{X_1, X_2, X_3, \cdots, X_n\}$, each data sample and y features $X_j = \left\{X_{j1}, X_{j2}, X_{j3}, \cdots, X_{jy}\right\}$ contained in the data sample, the feature matrix formula of the sample is as Equation (1):

$$X_{n\times y} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1y} \\ x_{21} & x_{22} & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{ny} \end{bmatrix} \tag{1}$$

Then the fuzzy classification matrix of n samples divided into K classes is shown in Equation (2):

$$X_{n\times K} = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1n} \\ v_{21} & v_{22} & \ddots & \vdots \\ v_{K1} & v_{K2} & \cdots & v_{Kn} \end{bmatrix} \tag{2}$$

The following three conditions need to be met, such as Equation (3), Equation (4), Equation (5).

$$0 \leq v_{ij} \leq 1; i = 1,2, \cdots, K; j = 1,2, \cdots, n \tag{3}$$

$$\sum_{i=1}^{k} v_{ij} = 1; j = 1,2, \cdots, n \tag{4}$$

$$\sum_{j=1}^{n} v_{ij} > 0; i = 1,2, \cdots, K \tag{5}$$

To define K cluster centers, the general approach involves initializing or calculating the positions of these centers, usually as vectors in a given feature space. In the context of a clustering algorithm, the formula could be presented as follows:

Given K clusters, let the cluster centers be $C_1, C_2, \ldots, C_K$, and the initialization or update of these centers can be represented as:

$$C_k = \frac{1}{|X_k|} \sum_{x_i \in X_k} x_i, k = 1,2, \ldots, K \tag{6}$$

where:

- C_k is the center of the *k*-th cluster.
- X_k is the set of data points assigned to the *k*-th cluster.
- $|X_k|$ is the number of data points in X_k.

- x_i represents a data point in the feature space.

The NASM-OPT model is structured into distinct training phases that progress over time. These phases include stabilization endurance, strength endurance, hypertrophy, maximal strength, and power. Each phase addresses specific physiological adaptations that are crucial for the demands of cheerleading. The model's progression ensures that athletes are gradually exposed to more complex and intense movements, allowing them to build a solid foundation before advancing to more demanding exercises [10,11].

The first phase of the NASM-OPT model focuses on stabilizing the core muscles and improving the endurance of stabilizer muscles. This is particularly important in cheerleading, where maintaining balance and control during stunts is critical. During this phase, exercises that emphasize joint stability, such as single-leg squats or stability ball exercises, are implemented to improve the body's ability to resist unwanted motion and maintain proper alignment during dynamic movements. Biomechanically, stabilizing muscles around the core, ankles, and shoulders are engaged, reducing the likelihood of misalignment or injury during high-stress stunts and jumps.

Athletes progressively develop muscular endurance while gradually incorporating heavier loads to enhance overall strength. In cheerleading, both muscular endurance—essential for sustaining prolonged performances—and strength—critical for executing powerful jumps and lifts—are indispensable. Biomechanically, this phase focuses on increasing the force production of key muscle groups involved in lifting and propelling the body, particularly the lower limbs (e.g., quadriceps and hamstrings) and the upper body (e.g., shoulders and arms). Strengthening these muscle groups provides athletes with greater control and power during complex stunts and acrobatic movements, ultimately enhancing performance while reducing the risk of injuries. Additionally, cheerleading instruction integrates a random consistency ratio for evaluation, as described in Equation (7). This approach ensures a structured and measurable progression in training effectiveness.

$$CR = \frac{CI}{RI} = \frac{0.0048}{0.9} = 0.0054 < 0.10 \quad (7)$$

The ultimate test of a model's consistency and validity lies in its application to objective practice. The process of understanding objective phenomena is not accomplished in a single step; rather, it unfolds as a dynamic, iterative progression, often resembling a spiral of continuous refinement and improvement, as illustrated in **Figure 1**.

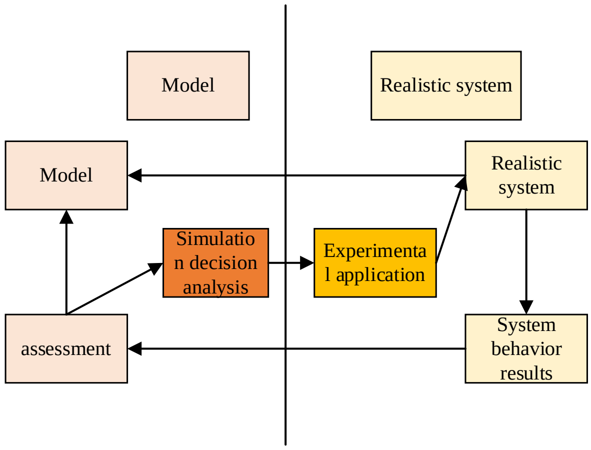

Figure 1. Optimization of the dynamic model of the cheerleading teaching system.

This iterative process reflects the interplay between theory and practice, where each cycle of application provides new insights and data that inform further refinements to the model. Such a methodology ensures that the model evolves to better align with real-world complexities [12].

Moreover, the spiral nature of this process underscores the importance of adaptability in model development. By embracing feedback from practical implementation, researchers can identify limitations, validate theoretical assumptions, and enhance the model's robustness and generalizability. This cyclical approach is particularly crucial in fields where variables are dynamic and multifaceted, ensuring that the model remains relevant and effective over time.

Ultimately, the alignment of theoretical constructs with empirical evidence solidifies the credibility of the model, providing a foundation for its broader application and continued evolution.

Incorporating biomechanics into the NASM-OPT training model allows for more precise and targeted interventions that align with the specific movement demands of cheerleading. Biomechanics, which studies the forces acting on the human body during movement, helps to optimize the execution of cheerleading techniques by ensuring that the body moves efficiently and within safe limits. For example, understanding the mechanics of joint angles and muscle activation during stunts and jumps allows trainers to adjust the training process to correct posture, reduce stress on vulnerable joints, and improve the overall effectiveness of each movement [13,14].

For instance, biomechanical analysis can identify excessive strain on the lower back or knees during a cheerleading lift. Based on this information, the NASM-OPT model can be adjusted to include corrective exercises that strengthen the core and improve the alignment of the spine and pelvis, thus reducing the biomechanical load on these vulnerable areas. Similarly, exercises that enhance ankle stability and flexibility are emphasized to improve the execution of jumps and prevent common injuries like ankle sprains. Relationship with the real system During the experiment, the experimental group used the advanced mode and designed content of the NASM-OPT training model to conduct 12-week special physical training, while the control group was trained according to the traditional physical training content. After the 12-week experiment, the specific physical fitness indicators of cheerleading were tested, and the measured data were sorted and analyzed to draw relevant conclusions as **Figure 2**.

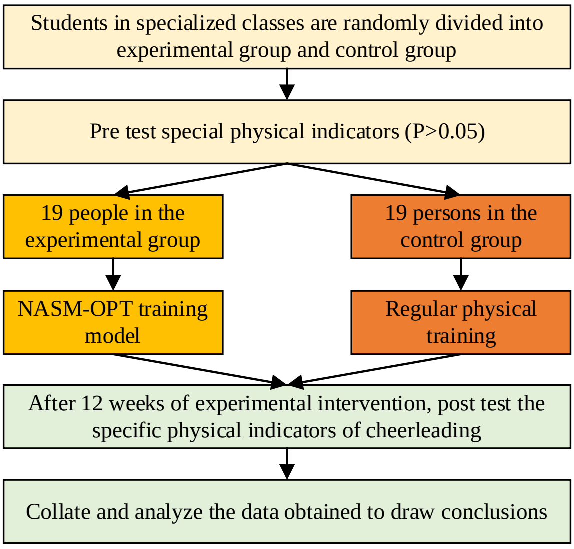

Figure 2. Design process of special physical training in cheerleading teaching.

The NASM-OPT model is such a cyclic process: in order to stimulate people's learning motivation or work motivation, first, let him pay attention to the learning content or work task, and then generate interest; secondly, let him understand that completing this task is related to his own motivation. Development is closely related to establish relevance; then let him feel that his ability can complete this thing well, and then build confidence [15]; finally, after he completes the task, give timely feedback and evaluation to gain satisfaction, as **Figure 3**.

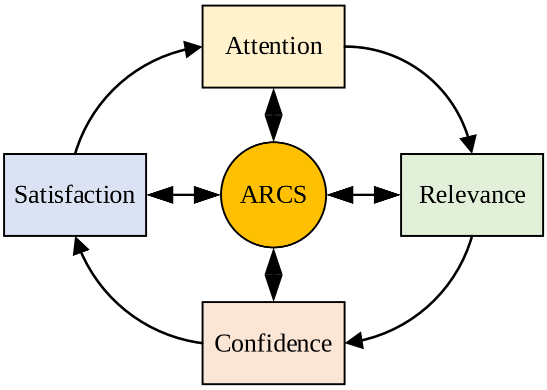

Figure 3. NASM-OPT motivation design cheerleading teaching model optimization.

3. Methods

3.1. Theoretical basis

Simple operation, unrestricted uploading and downloading of course materials, and ease of use for instructors to oversee online instruction are the guiding principles of the digital course network teaching platform. Students can acquire specific exercise techniques, develop a scientific mindset, and become proficient in cooperative inquiry and learning strategies through cheerleading instruction [16].

At present, a group of other industry players are entering under the competition pattern of the original enterprises consisting of Nessoft, Zheng fang, Dincauze, Linyi, Kangsar, etc. The educational information software product market has formed a diversified competition pattern. Studying the competitive advantage of educational information software market is an inevitable requirement to adapt to the market, and it has guiding significance for how to improve its competitive advantage. **Figure 4** is an example of a positive feedback system for cheerleading teaching. It enhances the construction of coaches and focuses on improving the coaches' own competitive level and teaching level, which will enhance the ability level of athletes, and the enhancement of athletic ability level will promote the overall development of the sports program.

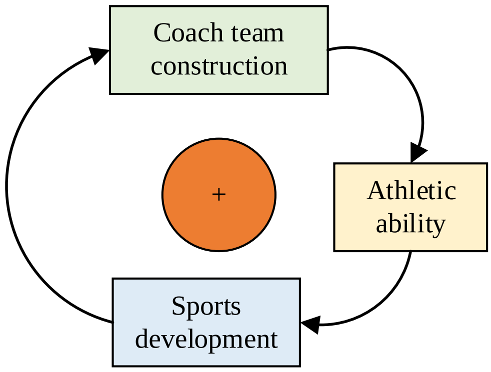

Figure 4. Positive feedback system for cheerleading teaching.

The main factor affecting the development of cheerleading is the lack of attention from school leaders. Most school leaders pay more attention to the development of the three major balls, and then ignore and ignore the development of cheerleading teaching, resulting in stagnant cheerleading teaching; As an emerging project, the lack of high-level coaches is also the main obstacle to the development of cheerleading; the lack of venue equipment not only makes it impossible for students to carry out cheerleading activities, but also other sports activities cannot be carried out smoothly, and students' physical and mental health cannot be fully developed [3]. The government's lack of attention to sports has affected the shortage of project funds, and there are few middle schools that can be sponsored by enterprises, which seriously affects the teaching of cheerleading. For the analysis of the relationship between positive and negative feedback loops, the author combines qualitative and quantitative to find the internal laws for promoting the development of cheerleading reserve talents, which lays a solid foundation for subsequent research. Through the system dynamics software Genism, the causal relationship is drawn to the cheerleading reserve talent system in my country.

It is proposed that we should optimize teaching and find corresponding solutions from different problems, to maximize the effect in the teaching process, provide students with efficient cheerleading classes, and provide a basis for the development of major universities. This experiment was a single-blind experiment, and **Table 1** shows the arrangement of the elective courses:

Table 1. Arrangement of the classroom content of the elective courses for cheerleading in the experimental group and the control group.

Course structure	experience group	control group	Duration (min)
Preparation	Classroom routine Action preparation Classroom content review New class content break	Classroom routine Action preparation Classroom content review New class content break	10
Basic components	Consolidate newly taught content Specific physical training (according to the training stage and content designed by NASM-OT training model)	Consolidate newly taught content Special physical training (according to the regular physical training content)	75
Closing section	Summary after class	Summary after class	5

Notes: Explanation of **Table 1**: Classroom arrangement for elective cheerleading courses.

The table compares the structure and implementation of cheerleading elective courses in the experimental group (utilizing the NASM-OPT training model) and the control group (following traditional methods). Below is a detailed breakdown of each section:

3.1.1. Course structure

This outlines the three main phases of the cheerleading elective course:

- Preparation phase: Establishing routines, warming up, and reviewing previous class content to prepare students physically and mentally for new material.
- Basic components phase: Focusing on the main content of the class, including physical and skill training.
- Closing section: Summarizing the session to reinforce learning and provide feedback.

3.1.2. Experimental group vs. control group

- Preparation phase (10 min): Both groups follow a similar structure, including classroom routines, action preparation, and content review. This ensures all students are warmed up and ready for the core activities.
- Basic components phase (75 min): The experimental group incorporates specific physical training aligned with the NASM-OPT training model, which is systematically designed based on the current stage of training. This includes targeted exercises that address strength, flexibility, coordination, and other biomechanical demands of cheerleading. The control group conducts special physical training based on traditional or regular physical training methods, which may not be customized or stage-specific.
- Closing section (5 min): Both groups conclude the class with a summary to reinforce key points and ensure reflection on the day’s training.

3.1.3. Duration

The total duration of each session remains consistent for both groups, with 90 min allocated per class. This ensures comparability between the groups in terms of time spent on activities.

4. Key difference

The main distinction lies in the training methodology during the Basic components phase. The experimental group benefits from a tailored, biomechanically-informed NASM-OPT approach, which is hypothesized to yield better physical and technical outcomes compared to the more generic training methods used in the control group.

This structured comparison highlights the experimental group's focus on a systematic, personalized approach to cheerleading training, which is expected to lead to improvements in performance, movement efficiency, and injury prevention.

The scientific theory of human motion provides a strong foundation for the NASM-OPT training model. In the five stages included in its model, each stage has a specific goal, and the final goal is achieved through a systematic progression process [9]. It is a programmed and standardized process that can help trainers systematically. The NASM-OPT training model puts forward higher requirements for the coaches or other relevant personnel who use this model: the makers need to understand and master every component and every training element in the designed training plan fully and thoroughly. As well as the correct sequence of these training elements and components in practical application, fully understand how they will help the trainee. As can be seen from **Figure 5**.

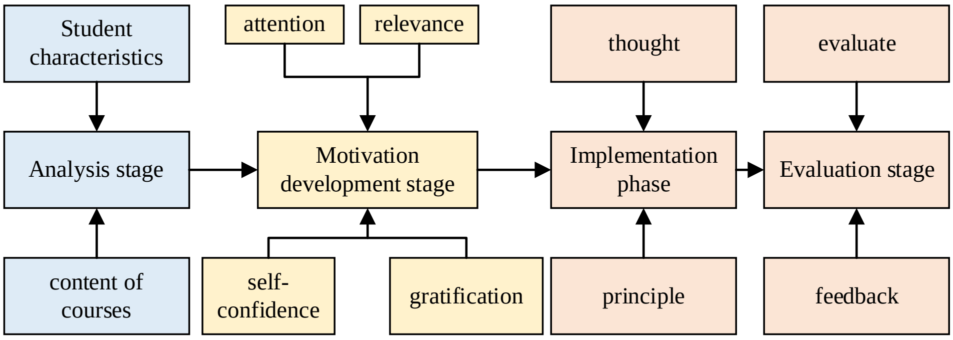

Figure 5. The flow chart of the implementation of the cheerleading teaching course.

Teaching practice cases

The creation and editing of cheerleading not only requires movement technology, but also content innovation, which is not only conducive to stimulating students' imagination, but also improves students' organizational ability and social adaptability in the process of group creation. Cheerleading exercises can develop and improve students' coordination, flexibility, sense of rhythm and expressiveness, shape students' beauty of movement, body, and temperament, and improve students' artistic accomplishment and ability to appreciate sports culture, the following analysis is made: the teaching content is mainly divided into theory, technology and practice parts, and the types of cheerleading lessons and the techniques of cheerleading movements are clarified. The specific content is as follows **Figure 6** shows:

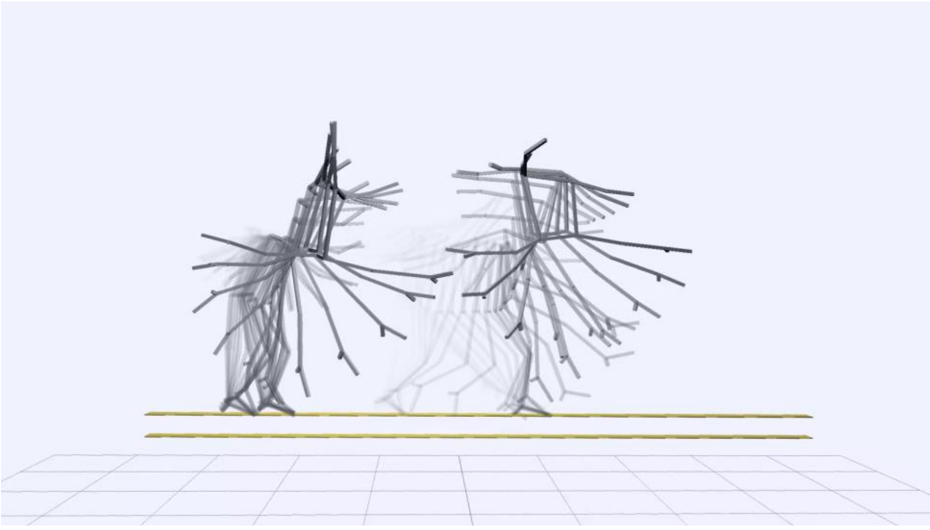

Figure 6. The specific content frame diagram of 3D cheerleading.

5. Case study

5.1. The influence of NASM-OPT motivation design model

Information software is a virtual and logical product. Information software research and development is a sophisticated, high-intensity brain labor process that demands a significant expenditure of scientific research money. Its initial research and development expenses are extremely significant. Product rivalry is increasing, market demand is becoming more human-oriented, technology and the market are changing more quickly, and educational informatization software technology is becoming more and more inventive and sophisticated. In the future, if manufacturers want to maintain their own market and take a place in the market competition, they need to strengthen the core competition of products. The OPT training model proposed by NASM (National Academy of Sports Medicine) is a planned and systematic design based on human exercise science. In the training of the three training cycles, each cycle has both a connection and its own focus, and each cycle can be adjusted according to the training situation of the trainer, as shown in **Table 2**.

Table 2. Period division and training content of cheerleading NASM-OPT training model.

Training cycle	Training content
Stability training period	Stability Endurance Training
	Strength and Endurance Training
Strength training	Muscle thickening training
	Maximum strength training
Rate (explosive power) training period	Power (explosive power) training

After learning cheerleading, the average lung capacity of the experimental group was 3377.43, the average standing long jump was 186.05, the average sitting forward bending was 23.603, and the average sit-up was 44.03, which were all greater than the average before the experiment, the average value of the fifty-meter run is 9.095, and the performance has improved compared with that before the experiment. We can get the number of repetitions, training volume, etc. that students need to practice in a specific stage, as shown in **Table 3**:

Table 3. Arrangement of training variables in stages of cheerleading NASM-OPT training model.

Training cycle	Stage characteristics	Repetitions	Number of groups	strength	Training rhythm	Between groups Length of rest
Stable training period	Stability Training (Phase 1)	12–21	1–4	50%–70% 1RM	Slow	0–90 s
	Muscle Endurance (Stage 2)	12–21	1–4	50%–70% 1RM	Slow	0–90 s
Strength training period	Muscle hypertrophy (muscle thickening) (stage 3)	6–13	3–6	75%–85% 1RM	Medium speed	0–60 s
	Maximum strength (muscle strength (stage 4)	1–6	4–7	85%–100% 1RM	Fast/explosive	3–5 min
Power training period	Power (explosive force) (phase 5)	1–11	3–7	30%–45% 1RM	Fast/explosive	3–5 min

The expert authority coefficient of this study is obtained from the average of the expert authority coefficients of 8 experts, Cr = 0.83 (two decimal places). Cr ≥ 0.7 is a good survey result, so the authority of the expert group in this study is relatively high, as shown in **Table 4**.

Table 4. The basis of expert judgment and the assignment table of the degree of familiarity with information software.

Index judgment basis	Judgment basis (Ca)			Thermal awareness (Cs)	assignment
	large	**in**	**Small**	**Very familiar**	**0.8**
practical experience	0.6	0.5	0.4	Familiar	0.8
theoretical analysis	0.4	0.3	0.2	General familiarity	0.6
Reference to domestic and foreign literature	0.2	0.2	0.2	Not familiar	0.4
Intuitive feeling	0.2	0.2	0.2	be unfamiliar with	0.2

Table 4 provides a structured framework for evaluating the judgment of experts regarding their familiarity with information software. It combines multiple factors that influence expert judgment with corresponding assignments reflecting the degree of familiarity. Here is a detailed explanation of each component:

5.1.1. Index judgment basis

This column outlines the five key factors influencing expert judgment:

- Thermal awareness (Cs): Refers to the general awareness and understanding of trends or developments in information software.
- Practical experience: Represents the extent of hands-on experience an expert has in using or interacting with information software.
- Theoretical analysis: Indicates the ability to analyze and understand software concepts and functionalities based on theoretical knowledge.
- Reference to domestic and foreign literature: Reflects familiarity gained from studying relevant academic or professional literature, both domestically and internationally.

- Intuitive feeling: Captures subjective impressions or instinctive understanding of the software.

5.1.2. Judgment basis (Ca)

The judgment basis indicates how strongly each factor influences the expert's decision-making. It is categorized into large, medium, and small impact levels, with higher values assigned to factors that carry greater weight.

For example, practical experience has the highest weight (0.6 for "large") compared to other factors, highlighting its significance in expert judgment.

5.1.3. Degree of familiarity

The degree of familiarity describes the expert's self-assessed level of familiarity with the information software. It is categorized into four levels:

- Very familiar: Experts with deep understanding and experience (assigned value: 0.8).
- Familiar: Experts with good but not extensive knowledge (assigned value: 0.8).
- General familiarity: Moderate level of knowledge or interaction (assigned value: 0.6).
- Not familiar: Limited or minimal familiarity (assigned value: 0.4).
- Be unfamiliar with: Little to no awareness or experience (assigned value: 0.2).

5.1.4. Assignment values

Assignment values are numerical representations that quantify the degree of familiarity and its impact. They provide a standardized way to assess and compare different levels of expertise.

Key observations:

- Practical experience and thermal awareness have the highest impact in determining expertise (higher "large" values), reflecting the importance of hands-on experience and awareness of software trends.
- Theoretical analysis and reference to literature carry lower weights, suggesting that practical application is prioritized over purely academic knowledge.
- Intuitive feeling, while included, is given the lowest weight (0.2 for all categories), indicating that subjective judgment has minimal influence on the evaluation process.

This table ensures a systematic and objective approach to assessing expertise, allowing for a balanced consideration of practical, theoretical, and experiential factors when evaluating familiarity with information software.

Under the condition that the teaching syllabus, teaching objectives, class hours, teaching venues and other factors are consistent, the experimental group uses the NASM-OPT motivational design as shown in **Figure 7**.

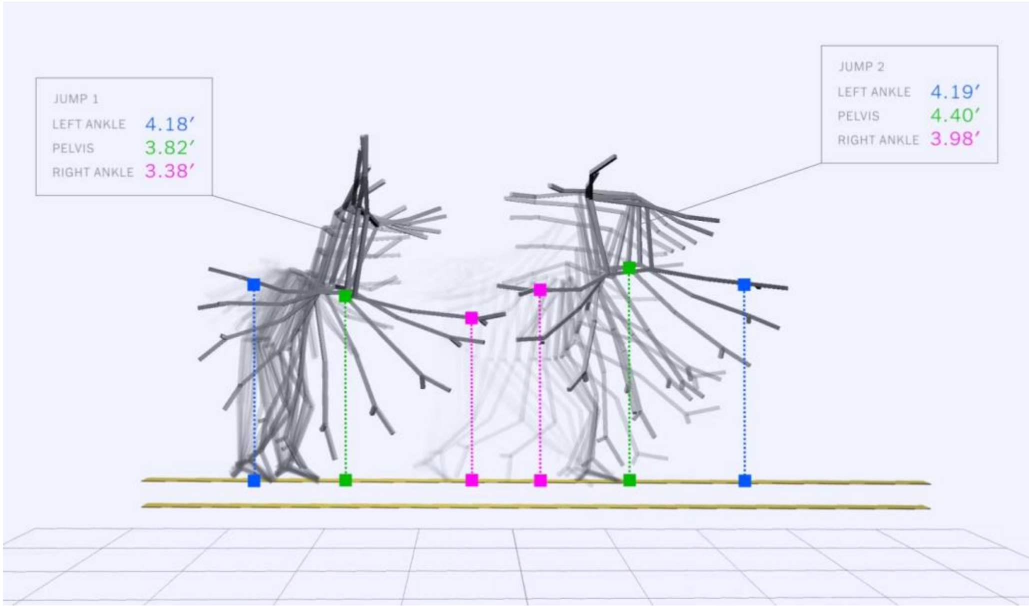

Figure 7. Average scores of the four dimensions of 3D cheerleading teaching.

In the classroom of OBE information software concept teaching, as **Table 5**.

Table 5. Cheerleading teaching content and hours allocation for the control group and the experimental group.

Group		Teaching Experiment	Credit hours	percentage
Control group and experimental group	Theory	Overview of cheerleading	3	11.2%
	Technology	Explanation, demonstration, and teaching of the prescribed routine of campus cheerleading	13	66.8%
	Activity class	Video appreciation and cheerleading competitions	3	11.2%
	assessment	Cheerleading Test	3	11.2%
	total		18	100%

To sum up, the application of the task-driven teaching model in cheerleading teaching is conducive to cultivating "applied" physical and artistic talents of cheerleading and is conducive to students' mastering the basic theory and methods of cheerleading and has the ability to practice cheerleading. Basic skills and innovation ability, capable of performing, teaching, training, and choreographing work in performing groups, schools, fitness clubs, communities, etc., and cultivating "virtual and artistic, physical and artistic compatibility" with sound personality and obvious social competitiveness. Quality cheerleading professional applied sports artist.

After the consistency test, it is obtained: Kendall coefficient WA was 0.316, with a value between 0–1, and a *P*-value for progressive significance was 0.027, $P < 0.05$. Referring to the results of various indicators, it shows that experts have a high degree of recognition for the selection of secondary indicators, the concentration of opinions is high, and there is no suggestion for revision of secondary indicators, so secondary indicators will not be revised after the first round of verification. Therefore, the secondary indicators of the special physical fitness of cheerleading are summarized as six items: fixed explosive force, same-direction non-fixed explosive force, anisotropic non-fixed explosive force, displacement balance, support balance, and 8 × 8 clapping position combination action, as shown in **Tables 6** and **7**.

Table 6. The rationality evaluation results of the selection of secondary indicators in the first round of cheerleading teaching (n = 8).

Level I indicators	Secondary indicators	average	standard deviation	Coefficient of variation	Modification comments
Collaborative explosive power	Fixed explosive power	3.63	0.52	0.12	
	Non fixed explosive force in the same direction	3.89	0.65	0.19	
	Non fixed explosive force in opposite direction	3.89	0.65	0.19	
dynamic equilibrium	Displacement equilibrium	4.38	0.75	0.18	
	Support balance	4.76	0.47	0.08	
Agile coordination	8 × 8 Clapping position combination action	4.63	0.52	0.12	

Table 7. Expert consistency test for the selection of secondary indicators in the first round of cheerleading teaching (n = 8).

Kendall W^a	Chi square	freedom	Progressive significance (P value)
0.317	12.629	5	0.028

After the experiment, compare and analyze the quality scores of the students. The results are shown in **Table 8**:

Table 8. Comparison of the quality scores of the test indicators in the experimental group after the cheerleading teaching experiment (n = 19).

Test index	group	$\bar{X} \pm S$	Difference	T	P
Quick big kick	Before the experiment in the experimental group	6.74 ± 1.32	−1.84	−5.837	0.00*
	After the experiment in the experimental group	8.56 ± 0.37			
Continuous fast body split jump	Before the experiment in the experimental group	6.75 ± 1.18	−1.95	−7.009	0.00*
	After the experiment in the experimental group	8.71 ± 0.33			
Continuous fast body split jump	Before the experiment in the experimental group	6.62 ± 1.18	−1.98	−1.176	0.00*
	After the experiment in the experimental group	8.61 ± 0.25			
Cross Lunge Push Center of Gravity	Before the experiment in the experimental group	7.29 ± 0.47	−1.36	−10.651	0.00*
	After the experiment in the experimental group	8.65 ± 0.31			
Vertical rotation	Before the experiment in the experimental group	5.85 ± 1.32	−2.71	−8.771	0.00*
	After the experiment in the experimental group	8.55 ± 0.29			
Closed eyes, single foot, straight knee balance	Before the experiment in the experimental group	7.52 ± 0.42	−1.15	−8.257	0.00*
	After the experiment in the experimental group	8.66 ± 0.44			
Hemisphere swallow balance	Before the experiment in the experimental group	7.45 ± 0.47	0.98	−7.628	0.00*
	After the experiment in the experimental group	8.45 ± 0.33			
8 × 8 Clapping position combination action	Before the experiment in the experimental group	7.61 ± 0.51	−7.513	−7.513	0.00*
	After the experiment in the experimental group	8.71 ± 0.38			

The results of **Table 8** confirm that the optimized cheerleading training program significantly improved the physical and technical performance of participants in the experimental group. The consistent improvement across all test indicators demonstrates the effectiveness of the training intervention in enhancing key cheerleading skills such as agility, balance, coordination, and rotational control. These findings validate the importance of a structured training approach tailored to the specific demands of cheerleading.

5.2. The influence of the NASM-OPT motivational

From **Figure 8**, it can be clearly seen from the trend line after the experiment.

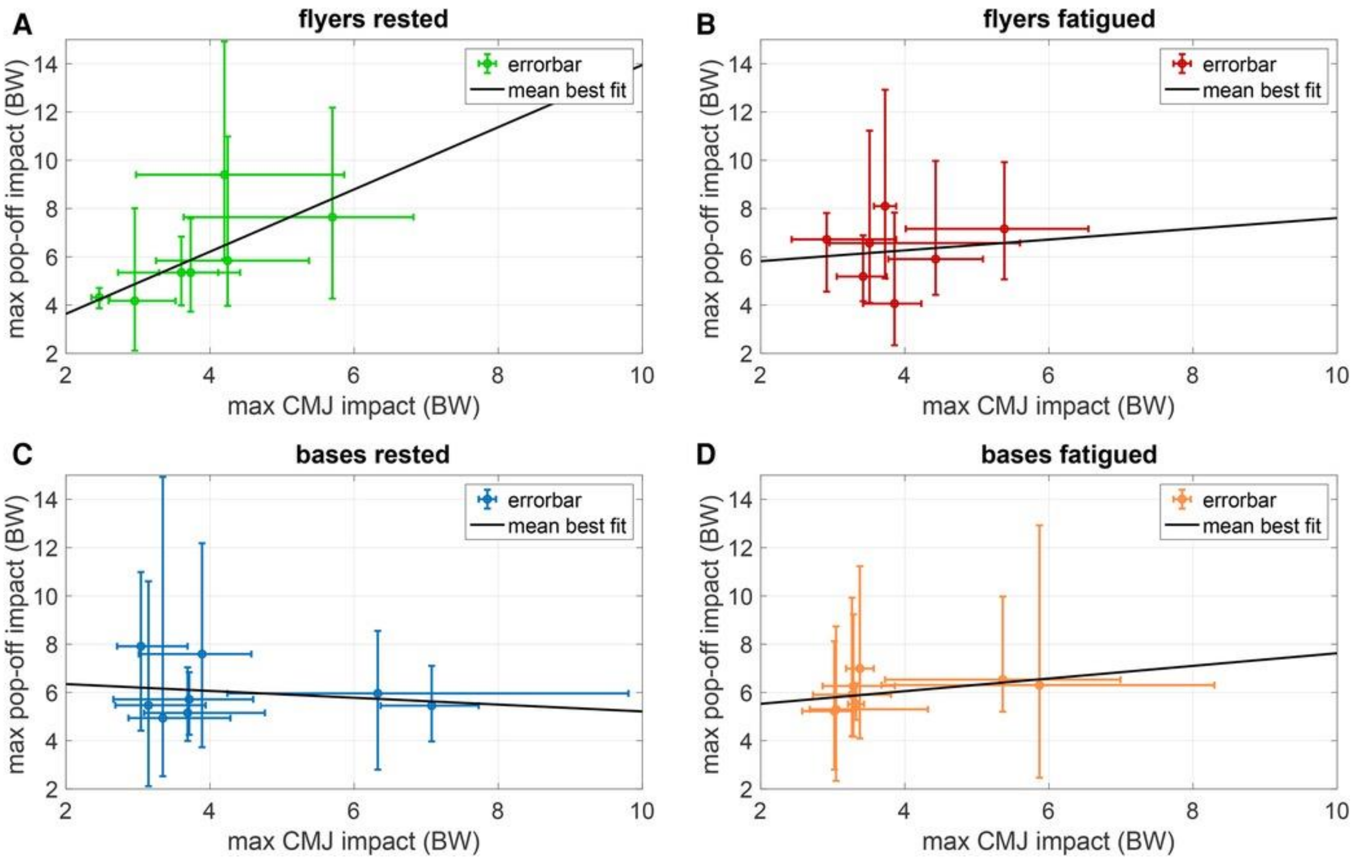

Figure 8. Comparison of the results of the control group and the experimental group before and after the cheerleading teaching experiment.

The training of applied talents in cheerleading not only needs to better cultivate and master the basic theory and methods of cheerleading, but also have the basic technical ability of cheerleading, and need to have the ability to innovate and create about cheerleading, which can be better.

The movements of cheerleading are short, powerful, and have a strong sense of rhythm. The standard requirements for the movements are relatively high. The basic hand positions of cheerleading have corresponded positions and the movements are connected naturally. When doing cheerleading, the muscles must be controlled. The sense of rhythm, the position, direction, and movement of the body must be accurate, and the action design must be novel and reasonable; the formation change of cheerleading, the novelty of the formation arrangement, and the flexible formation can bring the audience to the audience. It can enrich the content of the whole set of cheerleading and enhance the viewing value of the whole set of exercises. The overall time, action content and quantity all determine the timing and quantity of formation changes. It is necessary to ensure that the whole set of cheerleading movements is within on the premise of having a certain ornamental value, scientifically arrange the formation, find the best changing position in the process of practice, and enhance the cohesion between the team members; the overall ability of the cheerleading team is also an important part of the cheerleading creation factor, the output result of the four-dimensional structure diagram is shown in **Figure 9**.

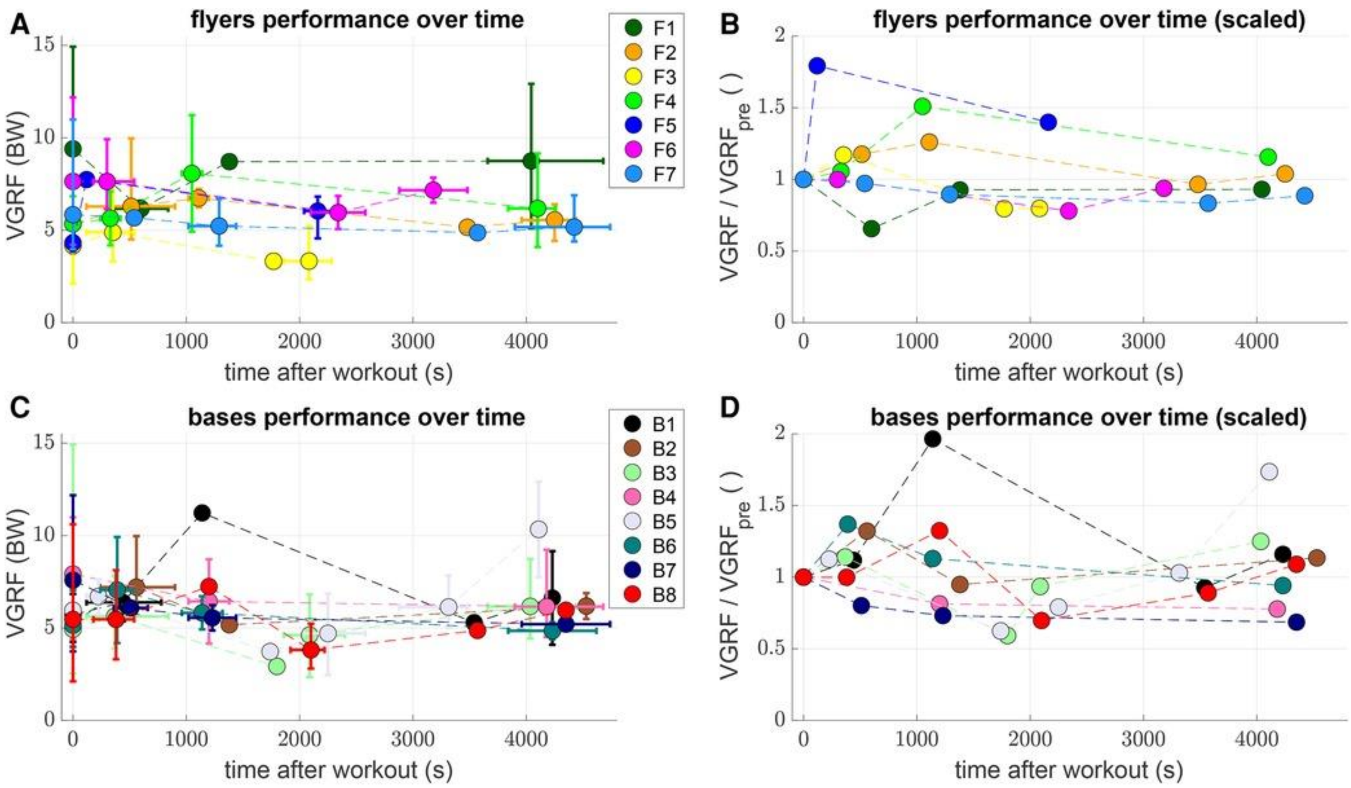

Figure 9. Test model diagram of cheerleading teaching shared mental model scale.

6. Conclusion

This study highlights the biomechanical optimization of the NASM-OPT training model in cheerleading, demonstrating its effectiveness in improving athletic performance while reducing injury risks. By integrating biomechanical principles into each training phase, we enhanced muscle function, joint alignment, and movement efficiency, crucial for cheerleading's dynamic and high-impact movements. The stabilization endurance phase promotes joint stability and alignment during stunts, while the strength and power phases focus on building muscle strength and explosive power, optimizing force generation for jumps and stunts. The biomechanical adjustments ensure that athletes can execute movements with precision, reducing stress on muscles and joints.

Additionally, biomechanical assessments allow for individualized training, catering to specific athlete needs based on body type, muscle imbalances, or injury history. This personalized approach maximizes performance and safety.

Ethical approval: Not applicable.

Conflict of interest: The author declares no conflict of interest.

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