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Influence of visual modelling on technical skill development in adolescent volleyball players

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Abstract
The present study investigates the influence of visual modelling on the development of selected technical skills in adolescent volleyball athletes. Rooted in the frameworks of observational learning and motor control theory, the study employed a quasi-experimental pre-test-post-test control group design. A total of 40 male volleyball players (aged 14-17) were purposively selected and divided into two groups: an experimental group (n = 20), which received structured video modelling sessions in addition to regular training, and a control group (n = 20), which followed conventional training protocols alone. The intervention lasted for eight weeks, focusing on technical skills such as serving, underhand passing, overhand passing, and spiking. Skill acquisition was measured using a standardized performance evaluation rubric validated by expert coaches. Statistical analysis was conducted using paired sample t-tests to assess within-group improvements and independent sample t-tests to examine between-group differences. The results demonstrated a statistically significant improvement ($p<0.01$) in the experimental group across all skill domains compared to the control group. Effect sizes, calculated using Cohen's d, indicated large practical significance ($d > 0.8$) for most skills. These findings confirm that visual modelling significantly enhances technical skill acquisition and motor learning efficiency among adolescent volleyball players. The study recommends the integration of video-based instructional strategies in youth training programs to accelerate learning and improve performance outcomes.

Keywords: Visual modelling, volleyball, skill acquisition, adolescent athletes, motor learning, video intervention, statistical analysis

Introduction
Skill development is a critical aspect of sports performance, particularly in technical sports such as volleyball, where precision, timing, and coordination are essential. Adolescent athletes are at a prime developmental stage for acquiring and refining fundamental movement patterns and complex skills. Traditional coaching methods—predominantly reliant on verbal instruction and physical demonstration—may not adequately cater to the diverse learning styles of young athletes. In this context, visual modelling has emerged as an innovative and effective instructional strategy.

Visual modelling involves exposing learners to video demonstrations of ideal performance, allowing them to observe, analyze, and mimic skilled movement. According to Bandura's Social Learning Theory (1977) [3], learning occurs through observation, imitation, and reinforcement. Mirror neuron theory also suggests that watching an action activates comparable brain circuits as doing it, enhancing cognitive-motor learning (Rizzolatti & Craighero, 2004) [6].

Despite theoretical support and anecdotal success in coaching, the empirical investigation of video modelling's effectiveness in developing volleyball skills at the adolescent level remains limited. This study aims to bridge that gap by examining how video modelling interventions influence technical skill development in school-level volleyball players.

Review of Literature
Previous studies have highlighted the effectiveness of visual feedback in improving athletic performance. Liebermann *et al.* (2002) [4] emphasized the role of video analysis in enhancing perceptual skills and movement correction. Arslan (2012) [2] found that video modelling significantly improved basketball shooting accuracy in youth athletes.

In volleyball-specific contexts, research by Abu-Dalbouh (2019) [1] demonstrated improvements in spike execution following structured visual feedback interventions.

Motor learning literature supports the use of augmented feedback, especially for complex, discrete tasks such as serving and spiking (Schmidt & Lee, 2011) [7]. Video modelling also complements explicit and implicit learning approaches by providing visual cues that reduce the cognitive load on beginners while reinforcing correct biomechanics.

However, much of the current literature focuses on elite or adult athletes, leaving a research gap regarding school-age learners. This study adds to the data supporting technology-enhanced learning in fundamental sports instruction.

Methodology

Participants

Forty male volleyball players (aged 14-17) from local schools were selected through purposive sampling. Participants were randomly assigned to:

- Experimental Group (n = 20): Received video modelling + regular training
- Control Group (n = 20): Received only regular training

Variables

- Independent Variable: Visual modelling intervention
- Dependent Variables: Scores in four volleyball skills-serving, underhand pass, overhand pass, and spiking

Intervention

Over 8 weeks, the experimental group received two 15-minute video modelling sessions per week before practice, showing ideal performance of each skill with slow-motion breakdown and expert commentary. Control group continued with standard drills and feedback.

Assessment Tools

Technical skill performance was assessed utilizing a systematic evaluation checklist established with professional volleyball coaches to ensure content validity and practical relevance. Serve, underhand pass, overhand pass, and spike were the checklist skills. Technique (correct biomechanical execution), accuracy (precision in targeting), and consistency (reliability in performance over several attempts) were used to rate each talent on a 10-point scale. This comprehensive and methodical strategy ensured objective and standardized skill improvement assessment throughout the intervention.

Statistical Tools

Statistical analysis was used to assess the visual modelling intervention's impact on technical skill development. Comparing pre-and post-test results within each group using a paired sample t-test assessed improvements over time. An independent sample t-test compared post-test scores between experimental and control groups to determine the intervention effect's statistical significance. Cohen's d was used to measure effect size, which shows group differences. To ensure validity and meaning in motor skill acquisition study, a significance level of $p<0.05$ defined statistical importance.

Results

Table 1: Mean Scores and Standard Deviations (Pre-and Post-Test)

Group	Skill	Pre-Test Mean ± SD	Post-Test Mean ± SD	t-value	p-value	Effect Size (d)
Exp	Serving	5.2±0.9	8.1±0.8	8.65	<0.001	1.94 (large)
Exp	U. Pass	5.0±1.1	7.9±0.7	7.43	<0.001	1.58 (large)
Exp	O. Pass	5.3±0.8	8.3±0.9	8.21	<0.001	1.88 (large)
Exp	Spiking	4.8±1.0	7.7±0.8	7.92	<0.001	1.83 (large)
Ctrl	All Skills	NS	NS	<2.0	>0.05	Low

Note: Exp = Experimental group; Ctrl = Control group; U. Pass = Underhand Pass; O. Pass = Overhand Pass
NS = Not significant

Table 1 shows that the visual modelling intervention improved all four technical volleyball skills—serving, underhand pass, overhand pass, and spiking—in the experimental group. Each skill showed substantial improvements ($p<0.001$) and large effect sizes (Cohen's d > 1.5), demonstrating both statistical and practical relevance. The control group did not improve across skills ($p>0.05$), confirming that the visual modelling method caused the improvements. These data strongly suggest that video-based therapies improve motor skill learning in adolescent volleyball players.

Discussion on Findings

This study proves that visual modeling improves teenage volleyball technical skills. Video demonstrations of serving, passing, and spiking improved performance significantly in the experimental group compared to regular training alone. These findings support Bandura's (1977) [3] Social Learning Theory, which stresses observational learning for behavior and skill acquisition. By observing competent performances, players might internalize movement patterns and practice them more correctly.

Video modeling had many benefits that presumably helped enhance these results. First, it repeated optimum motor executions to reinforce biomechanics through visual feedback. Second, video demonstrations reduced the cognitive load of verbal instruction, especially for younger athletes who struggle with complex cues (Magill & Anderson, 2017) [5]. Thirdly, the intervention movies used slow-motion and professional commentary to help athletes learn timing, coordination, and positioning—essential volleyball skills.

Statistical analysis confirmed intervention efficacy. Paired sample t-tests showed substantial gains within groups ($p<0.01$), while independent sample t-tests showed significant differences in post-test scores between experimental and control groups across all four skills. The Cohen's d values were larger than 0.8, indicating large impact sizes and emphasizing visual modelling's practicality. These findings indicate that the intervention was statistically significant and effective in coaching.

Previous studies have shown the effectiveness of video modeling in sports. Arslan (2012) [2] found that comparable strategies improved young basketball shooting accuracy, while Abu-Dalbouh (2019) [1] found that video-based feedback improved volleyball serving. The new study's focus on a wider variety of volleyball abilities and application in an understudied adolescent school population set it distinct.

Despite its benefits, the study had limitations. Male athletes

within a certain age range were sampled, therefore results may vary for female or older athletes. The intervention period was only eight weeks, therefore more research is needed on skill retention and competitive play.

Conclusions

The integration of video-based visual modelling significantly improves the technical skill performance of adolescent volleyball players. As a cost-effective and scalable instructional strategy, visual modelling holds considerable promise for enhancing motor learning in school and grassroots-level sports programs. Coaches and physical educators are encouraged to adopt video modelling as a complement to traditional teaching methods to accelerate skill acquisition and performance consistency.

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