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Effects of Video-Based Self-Recording With and Without Coach Monitoring on Beginners' Fundamental Tennis Skills: Controlling for Baseline Self-Efficacy

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Abstract

Study purpose. This study examined whether an exercise training model centered on self-recorded practice videos produces greater improvements in beginner tennis players' fundamental skills than unsupervised free practice, and whether outcomes differ by the presence of online coach monitoring. Accordingly, we compared (1) a monitored self-recording model, (2) an unmonitored self-recording model, and (3) a free-practice control, while controlling for baseline self-efficacy.

Materials and methods. An experimental pretest–posttest control group design involved 24 first-semester students (12 male, 12 female) from the Siliwangi University Tennis Club with no formal tennis training. Participants were randomly assigned to: (1) video-based self-recording monitored by a coach via online supervision, (2) video-based self-recording without monitoring, and (3) unsupervised free-practice control. The intervention lasted 12 weeks (3 sessions/week; 36 sessions). This training session lasted 120 minutes, including a 15-minute warm-up, 90 minutes of main training, and a 15-minute cool-down. The intensity of the training was controlled at a low to moderate level (60%–75% of HRmax). Forehand accuracy (FA) and backhand accuracy (BA) were measured using the Dyer Tennis Test, service accuracy (SA) using the Hewitt Tennis Achievement Test, and self-efficacy (SE) using the Endurance Sport Self-Efficacy Scale (ESSES). Paired t-tests assessed within-group changes, and MANCOVA tested posttest skill differences while controlling for pretest SE.

Results. Only Group 3 showed no significant improvement in BA ($p = 0.109$); Groups 1 and 2 significantly improved FA, BA, SA, and SE ($p < 0.005$). Group had a significant multivariate effect on posttest tennis skills after controlling for pretest SE ($p < 0.000$; $\eta^2 = 0.455$). Pretest SE significantly influenced FA, BA, and SA ($p = 0.021$; $\eta^2 = 0.409$), predicting posttest FA ($p = 0.027$) and SA ($p = 0.036$), but not BA ($p = 0.221$).

Conclusions. Video-based self-recording improves beginner tennis skills and self-efficacy beyond unsupervised free practice. Baseline self-efficacy should be considered in training design because it relates to post-intervention performance, particularly forehand and service accuracy. Future research should involve larger, diverse samples, include retention tests, and explore equipment modifications reported to enhance technical control and self-efficacy in beginners.

Keywords: Video-Based Self-Recording, Coach Monitoring, Self-Efficacy, Beginner Tennis Players.

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Introduction

Fundamental tennis skills constitute the primary foundation that beginner tennis players must master before progressing to more complex stages of play (Syahriadi et al., 2024). These skills include the forehand, backhand, and serve, which function as key means to sustain rallies and create scoring opportunities (Mulya et al., 2025; Jatra et al., 2025). Strong mastery of fundamental skills enables beginners to control shot direction, speed, and consistency, allowing them to play effectively and efficiently. Conversely, poor fundamental skills not only hinder playing performance but may also negatively affect beginners' psychological states during the training process (Ngatman et al., 2022). Therefore, mastery of fundamental tennis skills is an essential prerequisite for the early-stage development and coaching of tennis players.

Previous empirical evidence indicates that various factors, including physical, technical, and psychological components influence fundamental tennis skills in beginners. Physical factors include coordination, balance, strength, and agility (Maulana et al., 2025). Technical factors relate to movement understanding, timing, and equipment control (Putri et al., 2024). In addition, psychological factors play an equally important role in the acquisition of fundamental skills, particularly among beginners who are still in the learning stage (Deng et al., 2024). Psychological variables such as motivation, concentration, anxiety, and self-efficacy can affect the quality of technical execution during both training and skill testing (Zhou et al., 2025). Psychological unpreparedness often causes beginners to hesitate when performing movements, thereby contributing to lower shot accuracy and consistency (Filipas et al., 2024).

One psychological factor considered to have a significant influence on fundamental tennis skills is self-efficacy. Self-efficacy refers to an individual's belief in their capability to successfully perform specific tasks or skills (Saniah et al., 2024). In the context of beginner tennis, high self-efficacy may encourage players to take initiative, persist when facing difficulties, and consistently apply the technical movements being learned (Gimenez-Egido et al., 2023; Prabowo et al., 2025). Conversely, low self-efficacy tends to make players doubtful, more likely to give up, and inclined to avoid challenging training situations. Thus, self-efficacy not only serves as a supportive psychological factor but may also affect the quality and outcomes of fundamental tennis skill acquisition in beginners (Jaramillo et al., 2020).

Various training models have been developed to enhance both fundamental skills and psychological aspects in beginner tennis players, ranging from conventional training to technology-supported approaches (Liu et al., 2024). In particular, video-based training and video feedback have been increasingly used as learning tools because they provide concrete visual information that helps learners observe movement patterns, identify errors, and refine technique through repeated viewing and self-correction (Lin et al., 2020; Pujianto, 2021). From a motor learning perspective, video can strengthen movement awareness and support self-assessment, which may facilitate skill acquisition in beginners; similar benefits have also been reported in other racket-sport contexts when video performance technology is integrated into physical education settings (Feng et al., 2025). However, video-based training also has limitations. Without adequate guidance, beginners may misinterpret what they observe, focus on irrelevant cues, or repeatedly practice incorrect patterns, potentially reducing learning efficiency. Video-based training also requires additional time for recording and reviewing, and its effectiveness may depend on the structure and quality of feedback (Van Der Meer et al., 2024). Therefore, video-based training can be advantageous, but its outcomes may vary depending on whether learners receive structured support (e.g., coach monitoring) or rely solely on independent self-recording.

Previous studies have provided evidence that video-based approaches can improve sport skill learning. For example, video feedback systems in collegiate tennis classes have been associated with better forehand and backhand performance compared with conventional teaching (Lin et al., 2020), and video media has shown advantages over demonstration media for improving forehand groundstroke learning outcomes in novice tennis learners (Pujianto, 2021). Moreover, work on self-controlled video feedback in tennis suggests that allowing learners to request video feedback can enhance the learning of complex tactical skills, although psychological responses such as self-efficacy may not always change in parallel with performance (Van Der Meer et al., 2024). Despite these advances, a clear research gap remains: relatively few studies have directly compared (a) video-based self-recording with real-time coach monitoring, (b) video-based self-recording without monitoring, and (c) free-practice control within the same experimental framework for beginner tennis players. This comparison is particularly relevant because beginners often require feedback structure, while contemporary training environments increasingly rely on remote or resource-limited coaching settings (Rogers et al., 2020).

Accordingly, this study aimed to analyse and compare the effects of three training conditions: (1) coach-monitored video-based self-recording through online supervision, (2) video-based self-recording without monitoring, and (3) unsupervised free practice, on beginner tennis players' fundamental skills (forehand, backhand, and serve), while statistically controlling for baseline self-efficacy. The novelty of this study is grounded in the identified gap: unlike prior work that typically examined video feedback versus conventional instruction or focused on self-controlled feedback schedules, the present study simultaneously contrasts two distinct self-recording implementations (monitored vs unmonitored) against a free-practice control in a beginner population. This design clarifies whether the benefit of video-based self-recording depends primarily on the video itself or on the presence of structured coach oversight, thereby offering both theoretical insight into skill learning conditions and practical guidance for tennis coaching in settings with limited instructional resources.

Materials and methods

Study participants

The population of this study consisted of first-semester students participating in student activity units (UKM) at Siliwangi University, Indonesia, categorised as beginner tennis players. Specifically, participants were considered beginners if they were unable to consistently perform the three basic techniques with acceptable control and accuracy, as indicated by low baseline performance on the fundamental skill tests used in this study (Fauzan et al., 2024). Inclusion criteria included: (1) age 18–20 years, (2) good health and ability to engage in physical activity, (3) no history of musculoskeletal injuries, and (4) willingness to complete the full research protocol. Exclusion criteria were: (1) prior tennis training experience, (2) previous participation in tennis competitions, (3) attendance below 80% during the intervention, and (4) failure to provide informed consent.

The final sample comprised 24 students with the following characteristics (mean ± SD): 12 male students (height 167.3 ± 2.3 cm, weight 62.4 ± 8.3 kg, age 18.3 ± 4.5 years) and 12 female students (height 164.4 ± 5.2 cm, weight 54.6 ± 7.8 kg, age 18.2 ± 3.2 years). Participants were randomly assigned to three groups to ensure treatment independence and minimise selection bias, with each group consisting of eight participants balanced by gender (4 males and 4 females).

Study organization

This study employed a true experimental design with a pretest–posttest control group approach. Participants were randomly assigned to three groups: (1) a video-based self-recording group monitored directly by a certified tennis coach through online supervision (video-with-monitoring group), (2) a video-based self-recording group without direct coach monitoring (video-without-monitoring group), and (3) a control group that engaged in unstructured free tennis practice without specific intervention. Random assignment to the three groups was implemented to ensure treatment independence and minimise selection bias. Pretest self-efficacy scores were not used as a basis for group allocation but were instead statistically controlled during data analysis as a covariate. This approach aimed to maintain internal validity while accounting for baseline differences among participants.

The intervention was conducted over 12 weeks with a frequency of three sessions per week, resulting in a total of 36 training sessions (Bangari et al., 2025). This research design aimed to analyse differences in fundamental tennis skills between groups while controlling for self-efficacy as a covariate. To maintain internal validity, several extraneous variable control measures were implemented: (1) standardizationstandardization of training schedules and durations across all groups, (2) use of equivalent facilities and equipment, (3) monitoring of training intensity to prevent excessive participant fatigue, and (4) restriction of participants from engaging in additional tennis training outside the research program during the intervention period.

This study involved eight nationally certified tennis coaches: two coaches were assigned to monitoring duties for Group 1, while the remaining six served solely as on-site supervisors for Groups 1, 2, and 3. The role of the six supervisory coaches was limited to monitoring program compliance, overseeing training intensity, and supervising research assistants. These coaches provided no instructions, feedback, verbal interaction, or nonverbal cues to participants during the intervention.

Training sessions were recorded using digital cameras with a minimum resolution of Full HD (1080p) and a frame rate of 30 fps. Cameras were mounted on tripods at a height of approximately 120–150 cm from the court surface and positioned laterally to participants, ensuring full visibility of the athletes' bodies during training. Video recordings served as a medium for technical learning feedback, not for quantitative biomechanical analysis.

This study received ethical approval from the university (No. 0512/C3/DT.05.00/2025), adhering to research ethics principles aligned with the Declaration of Helsinki. All participants received comprehensive explanations of the study's objectives, procedures, and potential risks, and provided written informed consent prior to participation

Training Intervention Program

All training sessions were conducted at the indoor tennis court of Siliwangi University. Training times were standardised across groups: Mondays, Wednesdays, and Fridays from 15:30–17:30 WIB. Each 120-minute session included warm-up (15 minutes), main training (90 minutes), and cool-down (15 minutes). Training intensity was controlled at low-to-moderate levels (60%–75% HRmax) to maintain technical learning quality and prevent excessive fatigue. Prior literature indicates that muscle fatigue can induce long-term detrimental changes in motor skill learning, potentially hindering proper technique acquisition in subsequent sessions (Reid & Duffield, 2014; Forman et al., 2022; Behrens et al., 2023).

To clarify the treatment delivered in each session, the intervention procedures differed only in the feedback and supervision mechanism, while the training content, duration, and intensity targets were standardised. Group 1 (video-with-monitoring) followed the structured programme Table 1 and recorded practice drills; during each session, a nationally certified coach monitored the session synchronously via an online platform and completed a structured coach-feedback form (e.g., readiness, footwork, stroke execution, and drill compliance). The coach did not provide direct instruction to participants on court; instead, monitoring focused on ensuring that drills were executed according to protocol and that participants maintained the prescribed intensity. Group 2 (video-without-monitoring) followed the same structured programme and recorded the same drill segments; however, no coach monitoring occurred during the session. Participants completed a structured self-reflection form after recording to document perceived errors, correction plans, and session completion. Group 3 (free-practice control) trained for the same duration and schedule but did not receive the structured drill programme or video tasks; participants practiced freely using standard tennis activities (e.g., casual rallies, serving practice) without structured feedback or recording.

Table 1. Intervention Program for Group 1 and Group 2

Weeks	Technical Focus	Main Content	Exercise Variations	Intensity
1–2	Fundamental movement & grip	Grip introduction (eastern forehand), ready position	Shadow swing, wall drill without net	60%–65%
	Eye–hand coordination	Tennis ball toss & catch	Partner toss, static target	
	Basic footwork	Split step, side step	Simple ladder drill	
3–4	Forehand groundstroke	Static forehand swing	Drop feed, target area	65%–70%
	Ball direction control	Forehand cross-court	Short rally 5–10 strokes	
	Footwork	Side step + forehand	Side feed	
5–6	Backhand (1-hand/2-hand)	Static backhand swing	Drop feed backhand	
	Stroke consistency	Backhand cross-court	Short rally	
	Footwork	Recovery step	Alternating forehand–backhand	
7–8	Basic rally	Forehand–backhand combination	Controlled rally	70%–75%
	Direction control	Cross & down the line	Target cone	

Weeks	Technical Focus	Main Content	Exercise Variations	Intensity
9–10	Footwork	Split step + movement	Random feed	
	Basic serve	Ball toss, flat serve	Service box target	
	Serve consistency	Serve from half court	10–15 repetitions	
	Simple return	Slow serve return	Rally after serve	
11–12	Game-based drill	1 vs 1 mini game	Half court	
	Decision making	Situational rally	Point-based drill	
	Skill evaluation	Match simulation	Short game	

To ensure physical readiness before the intervention, researchers conducted a two-week, six-session non-tennis training program prior to the pretest. This program, comprising core training and brisk walking, aimed to prepare participants' neuromuscular systems, given their beginner status. Intensity was monitored and limited to 60%–70% HRmax.

Training sessions took place at Siliwangi University's indoor tennis court, featuring consistent surface conditions, nets, and lighting throughout the study. Court suitability was checked before each session. Participants used standardised tennis rackets (weight 260–280 grams, midplus head size, synthetic gut strings at medium tension) to minimise equipment-related performance variations.

Non-participant university students served as research assistants, handling equipment preparation (e.g., ball collection) and monitoring training intensity via perceived exertion scales. Assistants were prohibited from providing technical instructions or feedback to participants.

Research Instruments

The self-efficacy variable was measured using the Endurance Sport Self-Efficacy Scale (ESSES) developed by Anstiss et al. (2018). This 11-item instrument employs a 1–4 Likert scale and has been validated with ultra-endurance runners (Brace et al., 2020) and Indonesian youth aged 15–18 years (Saniah et al., 2024).

Technical skills were assessed using the Dyer Tennis Test for (1) forehand accuracy and (2) backhand accuracy, and the Hewitt Tennis Achievement Test for serve accuracy. The Dyer Test effectively measures beginners (Aksir et al., 2023) and youth players post-drill training (Maulana et al., 2025). The Hewitt Test evaluates serve accuracy in beginners following eye-hand coordination interventions (Riyadi et al., 2024) and grip variations (Nugroho et al., 2024), as well as gender differences among university students (Nugroho et al., 2023).

Dyer Tennis Test Procedure: Participants stood behind the baseline, receiving drop-fed balls. They alternated 10 forehand and 10 backhand strokes toward marked target areas on the opponent's court. Each stroke was performed once without repetition, following 2–3 practice attempts. Scoring: 2 points for target hits, 1 point for net-cleared shots landing out-of-bounds but on-court, 0 points for net touches or out-of-bounds. Total scores reflect groundstroke accuracy and consistency.

Hewitt Tennis Achievement Test Procedure: Participants performed 10 serves from behind the baseline (5 from right, 5 from left), targeting the diagonal service box, divided into scoring zones. Each serve was a single attempt without second serves, following 2–3 practice serves. Scoring: 2 points for the main target box, 1 point for the service box but outside the target, 0 points for net faults or out. Total scores indicate serve accuracy.

Group 1 monitoring used a structured observation format developed via focus group discussions and prior literature. Two coaches completed observations post-session, solely for technical skill evaluation, not data analysis. Table 2 presents the monitoring observation format.

Table 2. Coach Monitoring Format

Component	Description		
Athlete Name			
Week/Session			
Date			
Training Focus			
Session Duration	120 minutes		
Technical Aspects	**Assessment Indicators**	**Score(1–4)**	**Notes**
Ready Position	Stance before ball arrival		
Footwork	Foot movement toward the ball		
Forehand	Swing, ball contact, follow-through		
Backhand	Body position & swing		
Serve	Ball toss & swing		
Consistency	Stroke stability		
Aspects	**Coach Feedback**		
Technical Strengths			
Main Errors			
Immediate Corrections			
Improvement Suggestions			
Statements	**Score (1–4)**		
The athlete appears confident during training			
Athlete is willing to try new movements			
Athlete remains focused after mistakes.			

Statistical analysis

Data analysis was performed using SPSS version 27 (George & Mallery, 2021). Differences in basic tennis skills between groups were analyzed using paired sample t-tests. A Multivariate Analysis of Covariance (MANCOVA) was then conducted with post-test scores for each basic tennis skill test and self-efficacy as the dependent variables, and pre-test self-efficacy as the covariate. Assumptions tested in the paired t-test and MANCOVA included baseline normality and homogeneity. If a significant multivariate effect was found, the analysis was continued with univariate ANCOVA. The significance level was set at $p < 0.05$.

Results

Following pretest-posttest data collection, initial analyses tested assumptions of normality and homogeneity. Normality was assessed using the Shapiro-Wilk test due to sample sizes below 30 per group, with a significance threshold of 0.05 (Bernadett & Csaba, 2024).

Table 3. Shapiro-Wilk Normality Test Results

Variable	Group 1	Group 2	Group 3
	Sig.		
Pretest_Self_Efficacy	0.067	0.058	0.093
Posttest_Self_Efficacy	0.324	0.055	0.503
Pretest_Forehand_Accuracy	0.056	0.156	0.071
Posttest_Forehand_Accuracy	0.080	0.600	0.080
Pretest_Backhand_Accuracy	0.516	0.114	0.246
Posttest_Backhand_Accuracy	0.114	0.607	0.424
Pretest_Serve_Accuracy	0.274	0.220	0.792
Posttest_Serve_Accuracy	0.057	0.424	0.273

Table 3 shows that pretest-posttest values for all variables across the three intervention groups had significance levels $p > 0.05$, confirming normal distribution. Homogeneity testing followed, also using a 0.05 significance threshold.

Table 4. Homogeneity of Variance Tests (Levene's Statistic)

		Levene Statistic	df1	df2	Sig.
Pretest_Self_Efficacy	Based on Mean	0.236	2	21	0.792
	Based on Median	0.149	2	21	0.863
Posttest_Self_Efficacy	Based on Mean	6.954	2	21	0.205
	Based on Median	6.466	2	21	0.106
Pretest_Forehand_Accuracy	Based on Mean	0.377	2	21	0.691
	Based on Median	0.149	2	21	0.863
Posttest_Forehand_Accuracy	Based on Mean	4.514	2	21	0.323
	Based on Median	1.199	2	21	0.321

		Levene Statistic	df1	df2	Sig.
Pretest_Backhand_Accuracy	Based on Mean	0.503	2	21	0.612
	Based on Median	0.495	2	21	0.617
Posttest_Backhand_Accuracy	Based on Mean	0.636	2	21	0.539
	Based on Median	0.538	2	21	0.591
Pretest_Serve_Accuracy	Based on Mean	1.028	2	21	0.375
	Based on Median	0.968	2	21	0.396
Posttest_Serve_Accuracy	Based on Mean	0.741	2	21	0.489
	Based on Median	0.765	2	21	0.478

Homogeneity tests focused on Levene's statistic based on means. Table 4 indicates that pretest-posttest values for self-efficacy, forehand accuracy, backhand accuracy, and serve accuracy all showed $p > 0.05$ across groups, confirming samples from the same population. With normality and homogeneity assumptions met, analyses proceeded to paired-samples t-tests and MANCOVA.

Paired-samples t-tests examined pretest-posttest differences within each group post-intervention, using a two-tailed significance threshold of $p < 0.05$.

Table 5. Paired-Samples t-Test Results by Intervention Group

Pretest-Posttest	Group	Mean	Std. Deviation	Std. Error Mean	t	Sig. (2-tailed)
Self-Efficacy	1	9.250	1.165	0.412	12.458	0.000
	2	9.500	1.195	0.423	9.481	0.000
	3	2.875	2.232	0.789	3.643	0.008
Forehand_Accuracy	1	9.750	0.886	0.313	11.111	0.000
	2	6.625	1.598	0.565	8.726	0.000
	3	3.500	2.563	0.885	3.862	0.006
Backhand_Accuracy	1	8.875	0.991	0.350	7.329	0.000
	2	2.250	2.252	0.796	2.826	0.026
	3	1.625	2.504	0.885	1.836	0.109
Serve_Accuracy	1	9.375	1.768	0.625	15.000	0.000

Pretest-Posttest	Group	Mean	Std. Deviation	Std. Error Mean	t	Sig. (2-tailed)
	2	7.625	1.302	0.460	6.558	0.000
	3	3.125	1.008	0.865	3.101	0.017

Table 5 reveals significant pretest-posttest improvements in self-efficacy for Group 1 ($t = 12.458$; $p < 0.001$), Group 2 ($t = 9.481$; $p < 0.001$), and Group 3 ($t = 3.643$; $p = 0.008$). Forehand accuracy improved significantly across all groups (Group 1: $t = 11.111$; $p < 0.001$; Group 2: $t = 8.726$; $p < 0.001$; Group 3: $t = 3.862$; $p = 0.006$). Backhand accuracy showed significant gains in Group 1 ($t = 7.329$; $p < 0.001$) and Group 2 ($t = 2.826$; $p = 0.026$), but not in Group 3 ($t = 1.836$; $p = 0.109$). Serve accuracy improved significantly in all groups (Group 1: $t = 15.000$; $p < 0.001$; Group 2: $t = 6.558$; $p < 0.001$; Group 3: $t = 3.101$; $p = 0.017$).

Following paired-samples t-tests, MANCOVA proceeded, initially reporting multivariate tests via Pillai's Trace and Wilks' Lambda significance values.

Table 6. Multivariate Test Results

Effect		Value	F	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	0,767	19.726	0,000	0,767
	Wilks' Lambda	0,233	19.726	0,000	0,767
Pretest_Self_Efficacy	Pillai's Trace	0,409	4.154	0,021	0,409
	Wilks' Lambda	0,591	4.154	0,021	0,409
Group	Pillai's Trace	0,909	5,280	0,000	0,455
	Wilks' Lambda	0,116	11.648	0,000	0,660

Table 6 indicates that pretest self-efficacy as a covariate significantly influenced the combined posttest fundamental tennis skills (Pillai's Trace = 0.409; $F = 4.154$; $p = 0.021$; partial $\eta^2 = 0.409$). The group effect was also significant on fundamental tennis skills simultaneously after controlling for pretest self-efficacy, based on Pillai's Trace ($V = 0.909$; $F = 5.280$; $p < 0.000$; partial $\eta^2 = 0.455$) and Wilks' Lambda ($\Lambda = 0.116$; $F = 11.648$; $p < 0.000$; partial $\eta^2 = 0.660$). The second MANCOVA reporting phase analysed between-group differences after controlling for pretest self-efficacy, as shown in Table 7.

Table 7. Tests of Between-Subjects Effects

Source	Dependent Variable	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Posttest_Forehand_Accuracy	3	114.642	82.163	0.000	0.925
	Posttest_Backhand_Accuracy	3	87.369	46.165	0.000	0.874
	Posttest_Serve_Accuracy	3	22.712	14.273	0.000	0.682
Intercept	Posttest_Forehand_Accuracy	1	6.002	4.302	0.051	0.177
	Posttest_Backhand_Accuracy	1	18.729	9.896	0.005	0.331
	Posttest_Serve_Accuracy	1	89.659	56.347	0.000	0.738
Pretest Self Efficacy	Posttest_Forehand_Accuracy	1	8.804	5.736	0.027	0.223
	Posttest_Backhand_Accuracy	1	3.024	1.598	0.221	0.074
	Posttest_Serve_Accuracy	1	8.051	5.060	0.036	0.202

Group	Posttest_Forehand_Accuracy	2	59.162	42.401	0.000	0.809
	Posttest_Backhand_Accuracy	2	52.369	27.672	0.000	0.735
	Posttest_Serve_Accuracy	2	29.067	18.268	0.000	0.646

Table 7 demonstrates significant group effects on all posttest fundamental tennis skills after controlling for pretest self-efficacy. Forehand accuracy showed significant between-group differences ($F = 42.401$; $p < 0.001$; partial $\eta^2 = 0.809$). Backhand accuracy differences were also significant ($F = 27.672$; $p < 0.001$; partial $\eta^2 = 0.735$). Serve accuracy exhibited significant group differences ($F = 18.268$; $p < 0.001$; partial $\eta^2 = 0.646$). Pretest self-efficacy significantly predicted forehand accuracy ($F = 5.736$; $p = 0.027$) and serve accuracy ($F = 5.060$; $p = 0.036$), but not backhand accuracy ($F = 1.598$; $p = 0.221$).

Discussion

This study demonstrates significant between-group differences in fundamental tennis skills (forehand, backhand, and serve) at posttest after controlling for pretest self-efficacy. These findings indicate that structured training models in the intervention groups produced more targeted improvements in technical skills compared to unstructured free practice in the control group. The results affirm that structured interventions are more effective for enhancing stroke accuracy among beginner tennis players.

These findings align with university-level tennis learning studies reporting that video feedback systems (including technology-supported approaches) significantly improve forehand and backhand techniques compared to baseline conditions and control groups (Lin et al., 2020). The results are also consistent with experimental research comparing demonstration versus video media for beginner forehand skills, which showed learning outcome differences when video served as the instructional medium (Pujianto, 2021). Thus, video functions as concrete visual feedback that helps beginners develop movement understanding and technical corrections more effectively. In the present study, these prior findings provide the most direct support for the two video-based models (Groups 1 and 2), which both involved structured drills accompanied by self-recording activities.

Theoretically, video recording strengthens motor learning through augmented feedback and enhances observational learning. Beginners can review movement patterns, identify errors, and adjust in subsequent attempts. This aligns with Lin et al.'s (2020) argument that video makes learning more intuitive and accelerates movement model formation. Similar findings appear in table tennis, where structured video performance technology improved skill acquisition and enabled participants to analyse and refine movements (Feng et al., 2025). Accordingly, the improvements observed in Group 2 suggest that self-recording alone can already facilitate self-observation and self-correction, although the accuracy of error detection may vary across learners.

Beyond video itself, training effectiveness was influenced by program structure and monitoring. Technology-based training supervision studies emphasise that oversight ensures execution quality and enhances program effectiveness (Borisova & Volnov, 2025; Srinivasan M, 2025). More broadly, coach-led approaches tend to yield more positive training perceptions and better compliance than fully independent practice (Rogers et al., 2020). In this study, guided or monitored video recording can be understood as scaffolding that reduces repetitive technical errors and keeps practice aligned with technical learning objectives. In this study, Group 1 (coach-monitored video self-recording) likely benefited from additional scaffolding, as coach monitoring helped ensure that drills were completed according to protocol and reduced the likelihood of repeating incorrect movement patterns. In contrast, Group 2 (unmonitored video self-recording) relied primarily on learners' ability to self-assess from recordings, which may lead to more variable correction quality despite following the same structured programme. Meanwhile, Group 3 (free-practice control) lacked both structured drills and systematic feedback routines, which may explain why technical gains could be less consistent than in the structured video-based conditions.

MANCOVA results show that pretest self-efficacy significantly influenced combined fundamental tennis skills, with univariate analyses indicating relevance particularly for forehand and serve accuracy. This supports sports learning literature emphasising that self-efficacy affects task engagement quality, persistence, and consistency in retrying difficult movements (Lin et al., 2021; Piquer-Piquer et al., 2025). However, pretest self-efficacy showed no significant effect on backhand accuracy. This pattern may reflect that forehand and serve in beginners demand control, execution confidence, and decisive action (Caprioli et al., 2025), while backhand often feels biomechanically less comfortable, making coordination and basic technique more dominant than confidence alone (F. Liu, 2024). Conversely, tactical tennis learning via self-controlled video feedback found performance gains not always predicted by self-efficacy, with no between-group self-efficacy differences (Van Der Meer et al., 2024). These discrepancies may arise from skill characteristics (tactical vs. fundamental) and participant levels (intermediate vs. beginner), where initial self-efficacy plays a stronger role in beginners' technical execution.

Significant self-efficacy improvements across all groups likely stem from regular training exposure, tennis familiarisation, and 12 weeks of successful movement task experiences. This is consistent with findings that participatory and reflective learning strategies boost self-efficacy in both face-to-face and online formats (Roldan & Reina, 2021; Zhang et al., 2023). However, Roldan and Reina (2021) confirm that while self-efficacy increases, between-group technical skill differences persist, underscoring training quality and structure as key determinants of optimal technique gains. Thus, even if Group 3 improved in self-efficacy through repeated exposure, the absence of structured drills and feedback may have limited the precision and consistency of technical improvement compared with Groups 1–2.

The implications of these findings support video recording as an effective technical learning approach for beginning tennis players, especially when coaches need to reach large groups or face-to-face access is limited. Video-based models enrich visual feedback, strengthen self-reflection, and enhance technical correction consistency. The results align with trends in motion analysis technology and automated monitoring development (Bai, 2025; Chen et al., 2025), providing a foundation for more technology-integrated beginner tennis training interventions, whether coach-supervised or digitally supported. This study has limitations, including a relatively small sample size and single-institution participants, requiring cautious generalisation. It also lacked retention testing (e.g., one-week pre-posttest) to confirm lasting learning versus temporary performance gains. Future research should involve larger, diverse samples, include retention tests, and explore equipment modifications reported to enhance technical control and self-efficacy in beginners.

Conclusions

This study concludes that beginner tennis training programs using video-based self-recording significantly improve fundamental tennis skills, specifically forehand, backhand, and serve accuracy. MANCOVA results revealed meaningful differences among the three groups at posttest after controlling for pretest self-efficacy, confirming that structured training models are more effective than unstructured free practice. Additionally, pretest self-efficacy served as a significant covariate influencing combined technical skills, particularly forehand and serve accuracy, underscoring the need to consider initial confidence levels when designing beginner training programs. Paired t-test findings showed improvements from pretest to posttest across most groups, though not all technical aspects progressed uniformly in the control group.

Practically, video-based self-recording training is recommended as an effective, adaptable technical learning strategy for developing beginner tennis players in university and community settings.

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Conflict of interest

The authors declare that they have no conflicts of interest

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