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Evaluating Basic Tennis Skills: The Application of International Tennis Number for College Students

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Abstract

Study purpose. Success in tennis is largely determined by the mastery of correct fundamental techniques from an early stage. Without biomechanically sound and efficient basic techniques, students will find it difficult to develop advanced game tactics. Field observations indicate that students' skill levels remain highly varied and tend to fall within the low-to-moderate categories. The use of the International Tennis Number (ITN) standard is highly relevant as it is an objective international rating system designed to measure a player's accuracy, depth, and power. This study aims to analyze the fundamental tennis technical skills of Sports Coaching Education (PKO) students at University Negeri Medan based on the International Tennis Number (ITN) standards.

Materials and methods. This research employs a quantitative descriptive design. The method used was a survey involving tests and measurements. The research subjects consisted of 126 respondents. The instrument utilized was the ITN On-Court Assessment, with data analyzed using descriptive statistics.

Results. The results show that the majority of respondents (97.6%) possess basic tennis technical skills at a beginner level, with the most frequent classification being ITN Level 8 (46.8%). Half of the respondents (50%) demonstrated "poor" proficiency in groundstroke depth. Regarding groundstroke accuracy, most participants fell into the "very poor" category (57.9%). Respondents generally exhibited "poor" ability in both volley depth (61.1%) and service competence (62.7%). In contrast, the mobility level was predominantly categorized as "moderate" (42.9%).

Conlusion. It is recommended that students engage in independent practice outside of lecture hours. Furthermore, the International Tennis Number (ITN) instrument should be implemented as a course completion standard or a prerequisite for students.

Keywords: Tennis, Fundamental Techniques, International Tennis Number
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Introduction

Systematically assessing technical competency in lawn tennis stands as a paramount imperative within the higher education physical education curriculum, specifically for optimizing the professional readiness of pre-service athletic instructors (Masrun et al., 2022). Contemporary tennis pedagogies emphasize that peak on-court performance necessitates a seamless synthesis of elevated cardiorespiratory capacities and highly reproducible stroke mechanics (Roetert & Groppel, 2001). As an intermittent, high-intensity repeated sprint discipline, the sport demands that collegiate players maintain optimal motor efficiency during rapid transitions between explosive physiological workloads and transient recovery periods (Fernandez et al., 2006). Given that competitive encounters frequently extend from one to over five hours (M. S. Kovacs, 2006), fortifying foundational technical proficiency functions not merely as an offensive or defensive asset, but as an indispensable biomechanical shield that minimizes cumulative musculoskeletal strain and limits injury risks such as low back pain (Campbell et al., 2016).

Within academic sports science, the absolute execution of core technical components specifically groundstrokes, serves, volleys, and overhead smashes is heavily governed by the precise kinetic chain coordination of the body (Association, 2004; Knudson, 2006). Biomechanical literature demonstrates that the spatial accuracy of forehand and backhand drives is intricately mediated by the angular velocity of the backswing and the deceleration pathway of the forward swing (Masrun et al., 2022). Furthermore, contemporary scholarship indicates that the considerable variability observed in undergraduate shot accuracy is profoundly influenced by the intersection of institutional instructional methodologies and the baseline latent motor abilities of individual students (Igoresky et al., 2026). To counteract these pedagogical variances, tertiary training regimens increasingly incorporate structured technical drills alongside plyometric interventions to structurally elevate movement agility, rapid body positioning, and targeted shot placement (Mulya et al., 2025).

However, a recurring obstacle in university-level tennis instruction is the high probabilistic distribution of technical errors exhibited by novice student cohorts (Delgado-García et al., 2019). During the critical stages of motor skill acquisition, chronic mechanical failures do not merely disrupt rally longevity and spatial control; they concurrently induce adverse psychological setbacks, including elevated sports anxiety and a severe degradation in situational self-efficacy (Alim & Yuliarto, 2022; Brown & Soulier, 2013). In response to the inherent constraints of traditional visual feedback, modern instructional designs have integrated innovative paradigms, such as multidimensional systematic feedback mechanisms (C. Zhang & Chen, 2024), interactive virtual reality systems (Miles et al., 2012; Neumann et al., 2018), and monitored video-based self-recording interventions (Agustryani et al., 2026). These technology-driven modalities are empirically proven to accelerate gross motor skill mastery, refine spatial-visual perception, and promote cognitive autonomy in sports learning (Magill & Anderson, 2010; Schmidt & Wrisberg, 2008).

Despite this substantial body of literature examining foundational skill optimization (Jatra et al., 2023), a significant pedagogical gap persists regarding standardized skill evaluation in higher education. The vast majority of existing tennis research remains heavily skewed toward the biomechanics of elite professional athletes, the dietary or physiological demands of national-level competitors (Munson et al., 2020), or isolated experimental data analyzing singular stroke interventions (Kurniawan & Suganda, 2021). Consequently, empirical frameworks that evaluate multi-component technical proficiency through globally recognized, uniform diagnostic instruments within undergraduate physical education populations remain fundamentally underdeveloped. Preliminary institutional observations reveal a stark disparity in fundamental technical execution among collegiate students despite their exposure to identical lecture hours and standardized training workloads. Without a rigorously objective, data-driven

diagnostic evaluation, university tennis programs remain overly generalist, subjective, and structurally unequipped to cater to the specific motor developmental stages of individual learners (Y. Zhang, 2024).

To decisively bridge this evaluative gap, this investigation deploys the International Tennis Number (ITN) framework as a robust, objective diagnostic infrastructure (Crespo & Reid, 2009). Sanctioned by the International Tennis Federation, the ITN paradigm offers a globally standardized methodology to quantify essential functional metrics, specifically isolating directional accuracy, stroke depth, and hit power (Crespo & Miley, 1998). Employing the ITN framework within a university cohort introduces a crucial scientific novelty: it transitions institutional evaluation away from subjective, instructor-biased qualitative observations toward an empirical, highly reproducible performance repository. This data-driven baseline is essential for executing precise curricular adjustments and fostering tailored pedagogical interventions.

Driven by this instructional necessity, the primary objective of this study is to execute an empirical evaluation of undergraduate tennis proficiencies through the structural lens of a research framework entitled: *"Evaluating Basic Tennis Skills: The Application of International Tennis Number for College Students."* The academic insights generated by this study are expected to systematically mitigate assessment biases in higher education sports courses, arm sports faculty with an evidence-based diagnostic instrument, and establish a scientific foundation for designing highly adaptive, student-centered tennis curricula.

Materials and methods

Study participants

The research population comprises all 144 students enrolled in the Lawn Tennis course within the Sports Coaching Education program at State University of Medan Universitas Negeri Medan, spanning six distinct groups (Classes A through F). This study employed a total sampling approach, designating the entire population as the primary sample. However, during the data collection phase, 18 individuals were excluded due to incomplete technical performance records. Consequently, the final analytical sample consists of 126 respondents whose data were fully verified.

Study Design

This study employs a descriptive research design, utilizing a survey methodology centered on standardized testing and measurement techniques. The primary objective is to provide an objective portrayal of students' fundamental tennis skills based on the International Tennis Number (ITN) framework. Following the principles outlined by (Sugiyono, 2016), this investigation observes the subjects in their natural state without introducing any experimental treatments or interventions.

Study organization

This study was conducted in strict adherence to the ethical guidelines outlined in the Declaration of Helsinki. The research protocol received formal approval and oversight from the Ethics Committee of Universitas Negeri Medan. Prior to data acquisition, all participants underwent a comprehensive briefing regarding the study's objectives, procedural frameworks, potential benefits, and any associated risks. Voluntary participation was formalized through written informed consent before students engaged in the International Tennis Number (ITN) assessment. Furthermore, respondents were explicitly informed of their right to withdraw from the investigation at any stage without incurring any academic or personal repercussions.

Statistical analysis

Data collection was executed using the ITN On-Court Assessment (Crespo & Miley, 1998), a standardized battery comprising several technical evaluations. This includes the Groundstroke Accuracy and Depth Test to evaluate baseline performance for both forehand and backhand wings, and the Volley Depth Test to measure net-play placement. Additionally, the Service Test was utilized to assess accuracy within the service boxes, while the Mobility Test recorded the players' footwork agility through timed sprints. The process began with a preparatory phase, ensuring all equipment—including courts, ITF-approved balls, and scoring apparatus—met professional standards. During the execution phase, participants performed the full ITN sequence under the direct supervision of certified testers. To ensure maximum objectivity, each subject completed two trials for every component. All results were meticulously documented on the ITN score sheets, with points awarded based on the specific landing zones of the ball.

The collected data were processed using descriptive statistical analysis to provide a clear overview of the findings. This analytical approach focuses on identifying the extremum values (maximum and minimum), frequency distributions, and percentage calculations. To ensure computational precision and facilitate efficient data processing, all statistical operations were performed using SPSS Version 24.

Results

Table 1. Frequency Distribution of Basic Tennis Skill Proficiency College Students at the State University of Medan Based on International Tennis Number (ITN) Standards

No.	Variable / Category	Frequency (f)	Percentage (%)
1	**Basic Tennis Skill Proficiency**		
	High Performance	0	0
	Advanced	0	0
	Intermediate	3	2.4
	Beginner	123	97.6
2	**ITN Level**		
	ITN 7	3	2.4
	ITN 8	59	46.8
	ITN 9	53	42.1
	ITN 10	11	8.7
3	**Groundstroke Depth Proficiency**		
	Excellent	0	0
	Good	0	0
	Moderate	60	47.6
	Poor	63	50.0
	Very Poor	3	2.4
4	**Groundstroke Accuracy Proficiency**		
	Excellent	0	0
	Good	0	0
	Moderate	0	0
	Poor	53	42.1
	Very Poor	73	57.9
5	**Volley Depth Proficiency**		

	Excellent	0	0
	Good	0	0
	Moderate	2	1.6
	Poor	77	61.1
	Very Poor	47	37.3
6	**Serve Proficiency**		
	Excellent	0	0
	Good	0	0
	Moderate	45	35.7
	Poor	79	62.7
	Very Poor	2	1.6
7	**Mobility Proficiency**		
	Excellent	5	4.0
	Good	53	42.1
	Moderate	54	42.9
	Poor	14	11.1
	Very Poor	0	0
	Total	**126**	**100**

The findings reveal that a vast majority of participants, accounting for 97.6%, are classified within the beginner category, with ITN Level 8 emerging as the most frequent tier at 46.8%. A detailed technical breakdown shows that half of the respondents (50%) struggle with groundstroke depth performing at an poor level. Regarding groundstroke accuracy, the proficiency is notably lower, with 57.9% falling into the very poor category. Similarly, net-play performance was suboptimal, as 61.1% of students demonstrated poor volley depth. The service component followed a comparable trend, with 62.7% rated as poor. Interestingly, on-court mobility was identified as the most developed fundamental skill, with 42.9% of respondents reaching a moderate proficiency level.

Discussion

Basic Tennis Skill Proficiency

Empirical evaluation utilizing the International Tennis Number (ITN) framework revealed a profound skewness in technical proficiency among the cohort, with a staggering 97.6% of participants classified strictly within the novice proficiency bracket, while merely a marginal 2.4% successfully advanced to the intermediate developmental stage. These metrics collectively demonstrate that the students' execution of foundational groundstrokes, serves, and volleys remains firmly anchored within the cognitive stage of motor learning. As theorized by Magil and Anderson (2010), individuals navigating this primordial phase must heavily dedicate cognitive resources to comprehending the explicit mechanical sequences of a movement. Consequently, this high cognitive load inherently induces inconsistent neuromuscular coordination, jerky cinematic transitions, and a high frequency of probabilistic technical errors during live ball exchanges.

This pervasive sub-optimal proficiency is critically mediated by the highly heterogeneous athletic specializations characteristic of the student population. As Sports Coaching majors, a substantial majority of the participants do not possess a primary background in racket sports, thereby limiting the robust motor programming required to process the complex, synchronized dynamics of ball-and-racket interactions. The fundamentally open-skill

nature of lawn tennis demands instantaneous, highly adaptive reactions to volatile and unpredictable ball trajectories.

According to Schmidt and Wrisberg (2008), such automated regulatory capabilities can only be forged through extensive, deliberate repetition and protracted contextual court experience. Without an elevated threshold of training intensity either engineered within the formal institutional curriculum or pursued via autonomous independent practice facilitating a qualitative leap from novice rigidity to fluid intermediate competency remains a formidable pedagogical challenge.

Beyond the constraints of prior specialized motor experience, technical achievement is structurally bounded by systemic institutional variables, most notably the quality of available infrastructure and the restricted allocation of academic credit hours. Lawn tennis exhibits a significantly steeper technical learning curve for absolute beginners than other mainstreamcourt games. The restricted contact hours inherent to a single-semester course are inherently insufficient, typically providing only a superficial overview of stroke mechanics while failing to advance students toward the autonomous stage of motor control. As emphasized by Crespo and Reid (2009) within the International Tennis Federation (ITF) pedagogical guidelines, transitioning from a novice designation to an intermediate threshold necessitates the consolidation of directional control, shot depth, and stroke consistency perceptual-motor attributesthat cannot be acquired instantaneously.

Nevertheless, this technical deficit highlights an urgent need for targeted methodological interventions. Prior empirical data indicates that basic tennis skill proficiencies, specifically the spatial accuracy of forehands, backhands, and serves, can be significantly accelerated through structured beginner training programs that strategically integrate video-based self-recording modalities (Agustryani et al., 2026). By implementing such technology-mediated self-reflective tools, the structural disparities in motor talent can be systematic mitigated, allowing university instructors to optimize student learning curves despite limited classroom contact hours.

Research data indicates that a staggering 97.6% of participants remain at a beginner proficiency level, with only a marginal 2.4% advancing to the intermediate stage. These findings suggest that the students' execution of groundstrokes, serves, and volleys is still confined to the cognitive stage of motor learning. As theorized by (Magill & Anderson, 2010), individuals in this initial phase prioritize understanding the mechanical sequence of a movement, which frequently leads to inconsistent neuromuscular coordination and recurring technical errors.

This suboptimal proficiency is largely influenced by the diverse athletic specializations among the students. As Sports Coaching majors, many individuals do not focus primarily on tennis, resulting in limited motor programming regarding the specific dynamics of the ball and racket. The open-skill nature of lawn tennis demands high adaptability to unpredictable ball trajectories, a capability that can only be developed through extensive repetition and prolonged on-court experience (Schmidt & Wrisberg, 2008). Without sufficient training intensity—either within the formal curriculum or through independent practice—transitioning from a novice level to a more competent stage remains a significant challenge.

Beyond prior experience, technical achievements are also shaped by infrastructure quality and the allocation of academic credit hours. Compared to other court games, lawn tennis presents a steeper technical learning curve for beginners. The limited contact hours within the classroom are often only sufficient for an introductory overview of mechanics, falling short of the autonomous stage of motor learning. As emphasized by (Crespo & Reid, 2009) in the ITF guidelines, transitioning from a novice to an intermediate level necessitates the development of directional control, shot depth, and stroke consistency—attributes that cannot be acquired instantaneously. Basic tennis skills, particularly forehand, backhand, and serve accuracy, are

greatly improved by beginner tennis training programs that use video-based self-recording (Agustryani et al., 2026).

ITN Level

The empirical diagnostic data derived from the International Tennis Number (ITN) assessment reveals an asymmetrical distribution of skill mastery within the student cohort, heavily concentrated at the lowest operational tiers. Specifically, the technical proficiency of the Sports Coaching students is predominantly clustered at ITN Level 8 (46.8%) and Level 9 (42.1%), followed by a minor representation at Level 10 (8.7%), while merely a marginal 2.4% successfully attain Level 7. These metrics collectively confirm that the vast majority of the undergraduate cohort is categorized as technical beginners who are only capable of sustaining brief rallies with severely restricted directional control. According to guidelines established by the International Tennis Federation (Crespo & Miley, 1998), players operating within levels 8 to 10 typically exhibit structural vulnerabilities in stroke consistency, spatial awareness, and functional court positioning. This baseline performance profile aligns with broader athletic surveys in higher education contexts, which indicate that pre-service sports educators encountering tennis as a rigid curricular requirement frequently prioritize the mechanical retention of fundamental stroke forms over elite, high-intensity competitive mastery (Fathurrahman et al., 2021; Masrun et al., 2022).

The heavy concentration of respondents within ITN levels 8, 9, and 10 structurally demonstrates that their technical execution in groundstrokes and serves remains tethered to the gross coordination phase of motor acquisition. At this developmental threshold, individuals exhibit a marked inability to maintain a sustained rally when confronted with volatile ball velocities or multidirectional, deep ball trajectories. As noted by Schmidt and Wrisberg (2008), the initial phase of motor learning is governed by an elevated cognitive load, wherein an athlete's neuro-attentional resources are almost exclusively exhausted by primary grip mechanics and foundational swing paths. Consequently, this high cognitive processing demand leaves minimal neuromuscular latitude for developing critical anticipatory cues or executing tactical adaptations. This mechanical rigidity is further exacerbated by the highly diverse athletic backgrounds of Sports Coaching majors, many of whom lack specialized long-term experience in court-and-racket sports (Igoresky et al., 2026). Without extensive competitive exposure beyond formal lecture hours, transitioning from this restrictive novice state to an automated stage of motor control remains a profound pedagogical challenge.

Conversely, the minimal representation of respondents at ITN Level 7 (2.4%) highlights that only a distinct fraction of the student population possesses the capacity to reproducibly execute consistent rallies at moderate paces with precise directional control. Within the ITF global framework, Level 7 serves as the critical gateway to the intermediate categorization, representing the exact developmental juncture where players begin to synthesize basic tactical implementation with fluid physical execution. As emphasized by Crespo and Reid (2009), reaching this milestone necessitates not only consistent ball clearance but also advanced control over shot depth and placement accuracy. Crucially, students who reached this tier demonstrated an anecdotal history of higher autonomous practice frequencies relative to their peers. This behavior strongly implies that independent court time and self-directed deliberate practice function as the primary catalysts for advancing past the novice thresholds. To bridge this systemic technical gap for the remaining 97.6% of the cohort, higher education curricula must transcend traditional instructor-led demonstrations by integrating innovative pedagogical interventions, such as systematic video-based self-recording and monitored feedback protocols, which are empirically proven to accelerate motor skill accuracy in beginner collegiate cohorts (Agustryani et al., 2026; C. Zhang & Chen, 2024).

Groundstroke Depth Proficiency

The forehand groundstroke serves as a primary tactical weapon on the tennis court, characterized by a ball-striking posture executed after the ball bounces, situated toward the lateral side of the player's anatomy (Masrun et al., 2022). While foundational literature underscores the distinct distributional frequencies of various stroke patterns (Brown & Soulier, 2013), mastering groundstroke mechanics is universally recognized as a prerequisite for competitive performance. However, the empirical findings from this cohort reveal a critical performance deficit, with exactly half of the participants (50%) demonstrating an inadequate proficiency level regarding groundstroke depth, and 47.6% achieving merely a fair rating. Within the paradigm of sports coaching science, ball depth operates as a primary metric for tactical efficiency; consistently landing the ball near the baseline is essential for neutralizing an opponent's offensive angles and dictating the overall tempo of match-play (Campbell et al., 2016). This widespread deficit among the undergraduate respondents underscores a substantial gap in foundational technical mechanics, which must be systematically solidified before advancing students toward more intricate coaching strategies (Crespo & Miley, 1998).

From a biomechanical standpoint, the forehand stroke is inherently more natural as it aligns directly with the dominant unilateral hand of most players, rendering it relatively easier to master (Campbell et al., 2016). Conversely, the backhand technique requires highly specific, deliberate practice due to its reliance on distinct and more complex multi-joint muscle coordination. This mechanical divergence emphasizes the profound necessity for a tailored, differentiated training approach in higher education sports courses to ensure balanced skill acquisition (Neumann et al., 2018). Consequently, optimizing instructional quality encompassing both innovative pedagogical methods and enhanced training intensity is vital to ensure that pre-service coaches master both stroke variants in an optimal manner, a principle fully congruent with established frameworks in technical athletic training (Miles et al., 2012).

The prevalence of poor-to-moderate groundstroke depth scores highlights a fundamental struggle among students in managing the precise ratio between ball velocity and vertical trajectory. As prospective athletic instructors, these students must comprehend that shot depth is intrinsically linked to net clearance heights; executing a trajectory that is overly flat frequently yields short balls that inadvertently invite immediate offensive pressure from opponents (Tubez et al., 2019). Mechanically, this inconsistent depth typically stems from an ineffective kinetic chain spanning from suboptimal weight transfer to unstable racket-ball contact points which ultimately dissipates linear momentum during the striking phase to rectify these systematic mechanical errors, literature suggests a diverse array of pedagogical interventions, ranging from traditional wall-media drills, rhythm drills, and automatic feeding machines to horizontal swing variations, part-methods, and fixed-target modifications designed to foster technical automation (Jatra et al., 2023).

Groundstroke Accuracy Proficiency

The empirical diagnostic data reveals a critical and profound deficit in groundstroke accuracy among the undergraduate respondents, with the entire cohort falling exclusively into the 'very poor' (57.9%) and 'poor' (42.1%) proficiency classifications; notably, not a single student successfully attained a 'fair', 'good', or 'excellent' rating. Within the paradigm of tennis tactics, spatial precision serves as a foundational cornerstone requirement, necessary for placing the ball into strategic zones to systematically manipulate an opponent's court positioning. This universal subpar performance underscores significant neurological hurdles in motor control and fine hand-eye coordination. These defensive metrics align seamlessly with the established biomechanical principle that shot accuracy is heavily contingent upon the spatio-temporal consistency of the impact point and the rigid stability of the racket face at the exact moment of ball contact (Knudson, 2006).

From a biomechanical perspective, the respondents' systemic failure to strike designated target areas is deeply rooted in an inefficient kinetic chain linkage. Achieving a high level of accuracy during groundstrokes necessitates a seamless, sequential synchronization spanning from footwork preparation and hip-to-shoulder rotation to a stable, goal-oriented follow-through phase. For pre-service coaching students, this widespread technical deficiency highlights a critical shortage of structured, high-intensity training hours required to advance motor acquisition from conscious cognitive processing to unconscious motor automation. Without strict adherence to these core biomechanical principles, both developing athletes and prospective instructors will inherently struggle to maintain shot precision, particularly when forced to adjust to the volatile pace and unpredictable directions of an opponent's ball (Roetert & Groppel, 2001).

This pronounced lack of technical mastery among coaching majors represents a critical pedagogical dilemma, given that an instructor's personal technical competence directly dictates their situational effectiveness in providing precise visual demonstrations and consistent ball feeding during future instructional sessions (Association, 2004). Consequently, implementing targeted, data-driven drilling interventions is an absolute necessity to structurally enhance the students' spatial control and technical consistency. Prior sports science literature demonstrates that structured footwork regimens and specialized court drill training methods significantly accelerate the optimization of groundstroke capabilities on the tennis court, consistently yielding highly successful developmental outcomes in collegiate cohorts (Jatra et al., 2023).

Volley Depth Proficiency

The empirical diagnostics indicate that the vast majority of the undergraduate respondents exhibit suboptimal volley depth, with 61.1% rated strictly within the 'poor' operational bracket and 37.3% falling into the 'very poor' classification; conversely, only a marginal 1.6% successfully reached a 'fair' proficiency threshold. This definitive performance trend suggests that most participants experience profound structural difficulties driving their net volleys toward the opponent's baseline, which represents a vital tactical component of effective transitional net play. Tactically, maintaining optimal depth during volleys is essential for applying immediate psychological pressure and systematically neutralizing an opponent's baseline ability to execute successful passing shots or defensive lobs (Crespo & Miley, 1998).

From a biomechanical standpoint, this widespread deficit in volley depth is closely linked to passive lower-body footwork and a critical lack of wrist joint stability at the exact moment of ball impact. Unlike full-swing groundstrokes, the execution of an effective volley necessitates a highly compact backswing and relies heavily on a proactive forward stepping motion to facilitate efficient linear weight transfer into the ball (Knudson, 2006). The total absence of any respondents reaching the 'good' or 'excellent' categories underscores a significant motor competency gap within the higher education tennis practicum curriculum for pre-service coaching students.

For prospective athletic instructors, the capacity to execute deep volleys serves as a fundamental pedagogical prerequisite, necessary for effectively teaching transitional play from the baseline to the net weaponization (Association, 2004). This institutional lack of depth often stems from positional hesitancy and spatial anxiety at the net, which inadvertently forces players to adopt a defensive approach where they merely deflect the oncoming ball instead of achieving sufficient shot penetration (Roetert & Groppel, 2001). Consequently, these findings highlight an urgent need for targeted training designs that prioritize anticipation drills alongside specialized core and forearm strengthening regimens to enhance racket head stability when confronting high-velocity ball trajectories.

Serve Proficiency

The empirical data demonstrates that a substantial 62.7% of participants exhibit a 'poor' service proficiency rating, followed by 35.7% operating at a 'fair' developmental level, and 1.6% categorized as 'very poor'; notably, not a single respondent successfully achieved the 'good' or 'excellent' performance benchmarks. This widespread technical deficit is highly critical given that the serve stands as the premier closed motor skill in tennis entirely insulated from an opponent's initial interference and functions as the primary tactical catalyst for establishing immediate point dominance on the court (Crespo & Reid, 2009). Within contemporary sports pedagogy, the integration of innovative teaching methods alongside an athlete's baseline motor skills profoundly mediates the overarching mastery of this complex stroke mechanism (Igoresky et al., 2026). Consequently, this pervasive lack of proficiency highlights significant neurological and biomechanical hurdles in fluidly synthesizing the multi-segmental movements required for an effective delivery.

For pre-service athletic instructors, a failure to meet these foundational service standards underscores a critical institutional need to systematically solidify primary technical mechanics. This mechanical reinforcement is a non-negotiable prerequisite for developing sound pedagogical content knowledge and ensuring effective future skill transfer (Crespo & Miley, 1998). Biomechanical observations within the student cohort indicate a frequent and pronounced deficit in executing a proactive leg drive, which directly results in insufficient vertical ground reaction force. Without this vital energy transmission through the ascending kinetic chain, the resulting serves lack both explosive power and spatial precision. Instead, players exhibit a compensatory reliance almost exclusively on unilateral upper-arm strength; this structural flaw not only decimates shot quality but significantly elevates the long-term risk of acute or cumulative shoulder pathologies (Roetert & Groppel, 2001).

Beyond raw technical execution, the high prevalence of suboptimal ratings underscores the students' severely limited mastery over diverse delivery modalities, including flat, slice, or heavy kick serves. The strategic ability to manipulate ball spin dynamics and spot placement constitutes a fundamental tactical requirement for applying immediate psychological and spatial pressure on opponents during match-play (Association, 2004). The complete absence of respondents within the upper-tier proficiency echelons strongly implies that current tertiary training protocols may have critically overlooked advanced kinetic variables, specifically shoulder-hip separation angles and rapid internal humeral rotation velocities (Tubez et al., 2019). Consequently, higher education tennis curricula tailored for coaching majors must urgently reprioritize sound service biomechanics and integrate rigorous, target-based drills to systematically elevate both the first-serve percentage and overall offensive efficiency.

Mobility Proficiency

The empirical findings reveal a notably positive trend in the undergraduate respondents' on-court mobility levels, with the highest concentrations clustered within the 'fair' (42.9%) and 'good' (42.1%) proficiency categories, while smaller segments successfully attained 'excellent' (4.0%) or fell into the 'poor' (11.1%) operational range. These descriptive diagnostics suggest that the participants possess a robust physical foundation for on-court movement, effectively encompassing rapid linear acceleration, eccentric deceleration, and dynamic multidirectional changes of direction. Within contemporary sports science, tennis mobility profoundly transcends mere raw sprinting speed; it fundamentally represents the complex neuromuscular capacity to achieve optimal body-to-ball positioning prior to actual shot execution (Crespo & Miley, 1998). This elevated achievement in the 'good' and 'fair' tiers reflects systemic physiological adaptations to the motor activities inherent to their tertiary athletic practicum courses, thereby allowing students to pursue the ball across the court with greater dynamic

efficiency compared to their proficiency in specific striking techniques (Roetert & Groppel, 2001).

The dominant combination of 'fair' and 'good' mobility ratings demonstrates that the participants have developed the fundamental footwork coordination necessary to maintain dynamic equilibrium and structural posture during high-intensity on-court transitions. Effective tennis locomotion is heavily reliant on the pre-activation split-step mechanism and elite lateral agility to seamlessly cover the court from the baseline to the net weaponization zones. Although the students' isolated technical striking skills such as serves or groundstroke accuracy exhibit profound deficits, their proficient locomotory capabilities allow them to successfully extend rally durations through a resilient defensive game. This structural finding aligns with the pedagogical principle that footwork efficiency operates as a strict prerequisite for successful technical execution, given that proper body-to-ball spatial positioning constitutes the ultimate key to shot precision (Tubez et al., 2019).

Nevertheless, even though the mobility scores systematically outperformed all other technical skill components, the 11.1% of participants languishing in the 'poor' category still necessitate urgent pedagogical attention and structured tracking. In lawn tennis, fluid on-court movement and rapid multi-directional navigation are significantly mediated by lower-limb explosive power, reactive agility, and functional joint flexibility (Association, 2004). Guna mengoptimalkan kelompok mahasiswa yang masih tertinggal ini, kurikulum keolahragaan perguruan tinggi dapat mengintegrasikan model latihan kombinasi antara *technical drills* dan latihan pliometrik, yang terbukti secara empiris mampu meningkatkan kelincahan gerak sekaligus akurasi pukulan secara simultan pada atlet remaja dan mahasiswa (Mulya et al., 2025).

Conclusions

The study concludes that a vast majority of respondents (97.6%) operate at a beginner proficiency level, with ITN Level 8 being the most prevalent tier at 46.8%. Specifically, half of the participants (50%) demonstrate 'poor' groundstroke depth, while groundstroke accuracy is generally rated as 'very poor' by 57.9% of the cohort. Furthermore, results show that 61.1% of students possess 'poor' volley depth, and 62.7% exhibit 'poor' service capabilities. In contrast, on-court mobility emerged as the most proficient skill among the group, with 42.9% of respondents achieving a 'fair' performance level.

To fix these technical gaps, coaches should encourage students to practice independently outside of regular class hours. Integrating the International Tennis Number (ITN) tool as a mandatory course benchmark or graduation requirement would also help maintain standardized student skills. Even so, readers should note that this study only looked at one specific institution, which limits how much these findings can be applied to student-athletes at other universities. Future projects need to broaden this baseline by gathering data from multiple campuses and testing how tailored training programs actually impact specific ITN skill scores.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirm that the paper is free of plagiarism.

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