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The Effect of Verbal, Visual, and Combined Instructions on Learning a Sports Skill: An Effective Instruction Approach for Enhancing Adolescent Sports Performance

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A B S T R A C T

Objective: The purpose of this study was to investigate the effect of verbal, visual and combined instructions on learning the simple forehand service skill of table tennis.

Materials and Methods: To achieve the objectives of the study, 36 right-handed female adolescents, aged between 14 and 16 years, were selected through convenience sampling and took part in the study. The study consisted of six phases including familiarity, pre-test, acquisition, post-test, retention, and transfer. During the familiarity phase, brief explanations about the criterion skill were provided. In the pre-test stage, each participant performed one block of 10 trials of the criterion skill. The acquisition phase included four sessions that in each session, participants—based on their assigned group (verbal, visual, or combined)—practiced three blocks of 10 trials of the skill. Immediately after completing the acquisition phase, the post-test was conducted, consisting of one block of 10 trials. The retention and transfer tests were administered 24 hours after the acquisition phase. Data were analyzed using descriptive and inferential statistical methods.

Findings: The results indicated that the combined instruction group showed significant improvement in acquiring the forehand simple serve skill ($p < 0.05$), while the verbal and visual groups did not exhibit significant changes. Additionally, in the retention and transfer stages, the combined group outperformed the other two groups, highlighting the positive effect of combined instruction on more stable learning and more effective skill transfer.

Conclusion: The results suggest that the combined instruction approach led to more stable learning and more effective transfer of the forehand simple serve skill in table tennis. This highlights the efficacy of combined verbal and visual instructions in enhancing adolescent sports performance.

Keywords: *Verbal instruction, visual instruction, Sports performance, Adolescent.*

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1. Introduction

For many years, sports scientists have insisted that physical exercise not only promotes health but can also, on its own, enhance the learning of a motor skill (1). Despite the undeniable role of physical exercise in health, motor skill performance and learning, researchers today believe that the neural-physiological changes occurring during the learning process cannot be achieved through physical exercise and activity alone (2). When learning a motor skill in formal training environments, information about how to perform the skill can be presented in several ways: verbal instructions, visual (demonstration) instructions, or a combination of verbal and visual instructions (3). Verbal instructions refer to short phrases or words that direct the learner's attention to an important feature of the environment or movement pattern. This type of instruction is provided in the form of verbal guidance by others and self-guidance through self-talk (4). In the development of the important role of visual instructions, Bandura (1969) proposed a new theory on how people learn through observation, overshadowing many previous hypotheses and conclusions. He coined the term "observational learning" to describe a set of behaviors acquired through observing the actions of others. He argued that just as we learn from observing the consequences of our own behavior, we also learn from observing indirect experiences (5). This has been confirmed in studies involving healthy individuals across different motor domains, including sports activities (6), novel motor tasks (7), and force-based tasks (8). Although observational learning is not more beneficial than physical practice alone or verbal instruction, it is an effective training method for learning motor skills, especially simple motor skills (9). In this regard, some experimenters believe that visual demonstration is the most effective method for transferring thought patterns and behaviors. On the other hand, other researchers argue that whenever possible, a combination of verbal and visual instructions should be used, as the most successful instructional method is a combination of verbal and visual instructions (4, 10).

Despite the positive impact of verbal and visual instructions on learning and performing sports skills, there remains disagreement among experts regarding the use and organization of instructions, either separately or in combination. Additionally, researchers do not agree on the principles for using instructions in simple skills. There is also no consensus on whether verbal instructions should be used first, followed by visual instructions, or vice versa when teaching sports skills, and there are still significant disagreements among researchers regarding these questions. Furthermore, there has been limited research on the topic of instructions. For example, in a study, verbal and visual instructions were used for a discrete skill (basketball set shot) and a serial skill (Layup). Results show that for the discrete skill, verbal instructions were as effective as visual instructions, but for the serial skill, this was not the case (11). It also seems beyond doubt that, whenever possible, we should use a combination of verbal and visual instructions. Providing combined instructions in both verbal and visual forms can sometimes save athletes time and energy. However, it may not always be feasible to use both types of instructions simultaneously. If this is the case, then we should strive to design verbal instructions that are easily understandable for learners and contribute to the enhancement of their athletic performance (12, 13).

Although numerous studies have explored verbal guidance and observational learning, challenges still remain in these areas (4-6). One key challenge is assessing the effectiveness of combining these two instructional methods compared to using each one independently. Just as decisions about what the coach should direct and how instruction should be delivered depend on the interaction between the learner, the coach, and the task, the choice of instructional method is also shaped by this triadic relationship (14, 15). Previous research has primarily focused on the effects of a single type of instruction—either verbal or visual—on motor learning ability and skill acquisition (3, 16-18). As a result, there is a noticeable gap in studies examining the impact of combining instructional methods on enhancing motor performance and learning. Therefore, the present study was designed to address this fundamental question: Can verbal or visual instruction alone effectively support the learning of a motor skill, or does the combined use of both types of instruction yield better outcomes in terms of motor performance and skill acquisition?

2. Methods and Materials

2.1 Study Design and Participants

The present study employed a quasi-experimental design and falls within the category of applied research. Efforts were made to control intervening variables as much as possible. The final sample consisted of 36 right-handed female participants, aged between 14 and 16 years, all neurologically healthy and free from motor impairments.

The participants were selected through convenience sampling and randomly assigned—based on their pre-test scores—into three groups of 12: (1) verbal instruction group (n = 12), (2) visual instruction group (n = 12), and (3) combined verbal and visual instruction group (n = 12). To ensure homogeneity among the groups, all participants were selected based on the same age range and handedness (right-handed).

The inclusion criteria for participation in the study were as follows: (1) being right-handed, (2) falling within the specified age range, (3) having a beginner level of skill in the target task, and (4) being neurologically healthy and free from any motor impairments. The exclusion criteria included: (1) having chronic neurological disorders such as stroke, traumatic brain injury, or severe visual and auditory impairments; (2) having motor injuries in the upper limbs (hands) that could interfere with performing the designated task; and (3) having experienced any musculoskeletal injuries within the past year.

The participants took part in the study through several structured phases. The familiarization phase was conducted to familiarize the participants with the execution of the target skill prior to formal testing. In the pre-test phase, each participant performed one block of 10 trials of the criterion task, which was a basic forehand service in table tennis. Based on the scores obtained during this phase, the participants were randomly assigned to one of three experimental groups: verbal instruction, visual instruction, or a combination of both. Following this, the acquisition phase was carried out across four training sessions. In each session, all participants practiced the target skill by performing three blocks of 10 trials using their respective instructional methods. Immediately after the acquisition phase, the post-test phase was conducted, during which each participant repeated one block of 10 trials under the same conditions as the pre-test, to assess immediate performance outcomes.

To evaluate the persistence of learning, a retention test was administered 24 hours after the completion of the acquisition phase. The choice of a 24-hour interval for the retention test was made because, according to various studies, this time period is recognized as an effective window for consolidation of information after practice. Moreover, in motor behavior research, this time interval is widely used to assess retention effects and consolidation (19). In this phase, participants again performed one block of 10 trials of the target skill. Lastly, the transfer phase was designed to assess the adaptability of the learned skill. In this phase, participants performed the task from the opposite side of the table, providing a new context for performance while maintaining the same skill requirements.

2.2 Measures

a) **Demographic Questionnaire**: This questionnaire gathered personal information such as age, sports history, and other relevant background data.

b) **Functions of Observational Learning Questionnaire (FOLQ)**: This questionnaire was developed by Cumming et al. (2005) to assess the cognitive and motivational functions of observational learning (20). The questionnaire includes three components (skill, strategy, and performance) and consists of 17 items rated on a 7-point Likert scale (ranging from "strongly disagree" to "strongly agree"). Before responding, participants were provided with an explanation of the questionnaire. Sample items include: “I use observational learning through my role models to change how I perform a skill,” “I use modeling to develop new plans and strategies in my mind,” and “I use modeling to understand what it takes to be mentally tough.” In a study, a confirmatory factor analysis showed that the model had a good fit ($\chi^2 = 361.218$, TLI = 0.926, CFI = 0.937, RMSEA = 0.096). Additionally, Cronbach’s alpha coefficients for the skill, strategy, and performance components were reported as 0.939, 0.937, and 0.936, respectively, indicating high reliability of the questionnaire (21).

c) **Table Tennis Target Service Test**: Another instrument used in this research was the table tennis target service test developed by Purashwani and Datta. This test has confirmed validity (approximately 0.82) and reliability (0.80). In this test, the table is divided into three scoring zones: a 15×30 cm area scores 5 points, a 40×80 cm area scores 3 points, and the remaining area of the table scores 1 point (22).

d) **General Health Questionnaire (GHQ)**: The GHQ was developed by Goldberg in 1972 and has been widely used for assessing psychological well-being. The GHQ is known for its acceptable validity (0.55) and high reliability coefficients (0.93, 0.70, and 0.90). In this study, the 28-item version of the GHQ was used, which includes four subscales, each consisting of 7 items.

2.3 Data Analysis

After data collection, descriptive statistics such as frequency distributions, measures of central tendency, and variability were calculated and presented in tables and

graphs. Inferential statistics were then applied to test the research hypotheses. Prior to conducting parametric tests, key assumptions—namely the normal distribution of data and homogeneity of variances—were examined using the Shapiro-Wilk test and Levene's test, respectively. A repeated measure analysis of variance (ANOVA) in a mixed-design format was employed to analyze the differences across the post-test, retention, and transfer phases. All statistical analyses were performed using SPSS version 26 and Excel version 2019, with the level of significance set at $p < 0.05$ for all tests.

3. Results

Table 1 presents the mean and standard deviation values for each group during the pre-test, post-test, retention, and transfer phases.

Table 1. Descriptive statistics (mean and standard deviation) of training groups in different phases.

Phase	Group	Mean	Standard Deviation	CI 95%
Pre-test	Verbal instruction	1.08	0.99	0.52 to 1.64
	Visual instruction	1.16	1.19	0.49 to 1.83
	Verbal-visual instruction	1.42	1.49	0.58 to 2.26
Post-test	Verbal instruction	2.34	1.30	1.60 to 3.08
	Visual instruction	2.58	1.56	1.70 to 3.46
	Verbal-visual instruction	3.50	1.78	2.49 to 4.51
Retention	Verbal instruction	2.59	1.78	1.58 to 3.60
	Visual instruction	2.91	2.62	1.43 to 4.39
	Verbal-visual instruction	4.30	1.37	3.52 to 5.08
Transfer	Verbal instruction	2.41	1.30	1.67 to 3.15
	Visual instruction	2.42	1.62	1.50 to 3.34
	Verbal-visual instruction	4.33	1.66	3.39 to 5.27

To investigate the effects of three types of instructional modalities (verbal, visual, and combined verbal–visual) on the acquisition and learning of the basic forehand serve in table tennis, a repeated-measures ANOVA was first conducted to examine performance changes during the acquisition sessions. The results indicated that the main effect of practice sessions was not significant in the verbal and visual groups, suggesting that participants in these groups did not show significant improvement in the skill during acquisition. In contrast, the main effect of acquisition sessions in the combined instruction group was statistically significant ($p < 0.001$, $\eta^2 = 0.41$), indicating that the combined instructional approach had a meaningful impact on the acquisition of the forehand serve skill.

To compare performance across the three groups, a mixed-design ANOVA was employed. The findings revealed a significant main effect of group ($p = 0.02$, $\eta^2 = 0.719$), while the interaction effect of group and acquisition sessions was not significant. Post hoc analyses showed that the combined instruction group performed significantly better than both the verbal and visual groups, suggesting that the integration of verbal and visual instructions is more effective during the acquisition phase than using either modality alone. Subsequently, to assess the effect of instructional types on the learning of the target skill—measured through post-test, retention, and transfer phases—a repeated-measures ANOVA (considering Mauchly's sphericity assumption) was conducted. The results demonstrated that the main effect of learning stages was significant in all three groups ($p = 0.04$ for verbal, $p = 0.08$ for visual, and $p = 0.001$ for combined), indicating that all instructional types contributed to the learning process of the forehand serve skill.

To further compare differences among groups across learning stages, a 3 (group) × 3 (learning stage: post-test, retention, and transfer) mixed-design ANOVA was applied. The results showed that only the main effect of group was significant ($p = 0.001$, $\eta^2 = 0.948$), while neither the main effect of learning stages ($p = 0.678$) nor the interaction between group and stage ($p = 0.963$) was statistically significant. LSD post hoc analysis indicated no significant differences between groups in the post-test phase; however, significant differences were observed in the retention and transfer stages, where the combined instruction group outperformed both the verbal and visual groups (all $p < 0.05$). Moreover, there were no significant differences between the verbal and visual groups across any of the learning stages. These findings suggest that combined verbal–visual instruction results in more stable learning and better transfer of the forehand serve skill in table tennis

compared to using verbal or visual instructions alone. The comparison of the mean scores of the groups across different stages is illustrated in Figure 1.

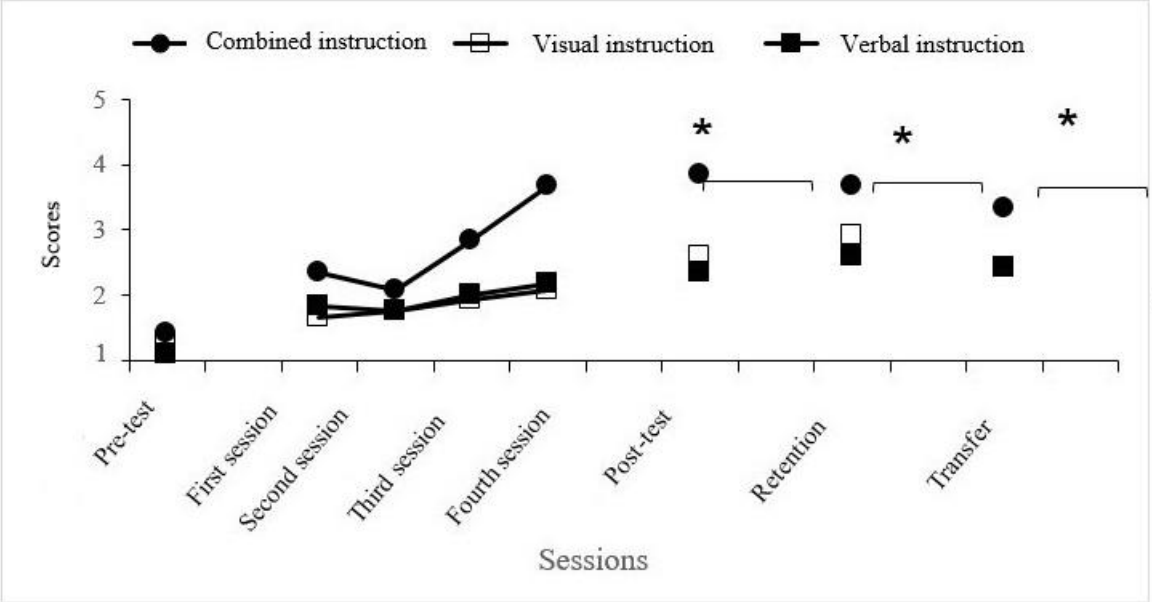

Figure 1. The average scores of the groups in the different test stages in table tennis service skill.

4. Discussion and Conclusion

The purpose of this study was to investigate the effect of verbal, visual and combined instructions on learning the simple forehand service skill of table tennis. The results revealed that all instructional conditions facilitated skill improvement during the acquisition phase. However, significant differences emerged among the groups in post-test, retention, and transfer phases, favoring the combined instruction group.

The superior performance of the combined instruction group supports earlier findings from Glaser and Schwan (12), Nishizawa and Kimura (23), Scott et al. (24). These studies emphasize that combining verbal cues with visual models facilitates the encoding process of skills and enhances performance during retention and transfer phases. When information is simultaneously received through both auditory and visual channels, more effective cognitive processing occurs, enabling learners to gain a deeper understanding of skill components through multimodal cues. This sensory-cognitive interaction, by increasing the activation of neural networks associated with perception and movement, creates a more stable mental representation of the skill in memory, thereby making information retrieval and accurate execution easier during retention and transfer conditions. Furthermore, the concurrent presentation of verbal and visual cues fosters semantic associations between what is seen and what is heard, leading to greater cognitive organization and reduced working memory load in the early stages of learning. These findings specifically extend Bandura's theoretical framework on observational learning, as they demonstrate that the addition of verbal elements alongside visual models not only enhances attention and encoding but also helps create more coherent semantic networks — an aspect that Bandura has addressed less explicitly. As a result, our findings highlight the role of simultaneously combining multi-channel stimuli as a novel mechanism for improving motor learning.

Notably, the group that received verbal instructions also demonstrated significant improvement across all phases of learning—acquisition, retention, and transfer. This finding aligns with theoretical perspectives that emphasize the role of verbal cues in directing learners' attention to the critical features of a task (4, 5, 10, 17). Verbal cues serve as attentional focusers, helping learners prioritize relevant aspects of performance and facilitating the selection and execution of appropriate motor patterns. This function is particularly valuable in the early stages of learning or when engaging with unfamiliar tasks, as it enhances perceptual processing, improves decision-making accuracy, and supports the development of effective performance strategies (25). Moreover, consistent with Schmidt's

Guidance Hypothesis, verbal instructions can reduce cognitive processing errors and increase movement accuracy, especially in complex tasks that place high demands on cognitive organization and decision-making (26). In this context, verbal cues assist learners—especially novices—in identifying task-relevant stimuli, encoding them into memory, and retrieving them more effectively during similar performance situations. Thus, even in the absence of visual modeling, verbal instructions play a vital role in supporting the acquisition and refinement of motor skills in sports.

Nonetheless, the results of the present study also confirmed the effectiveness of visual instruction in the learning of sport skills. According to Bandura's (1986) social cognitive theory of observational learning, this process is underpinned by four essential cognitive components: attention, retention, motor reproduction, and motivation. Within this framework, visual models play a crucial role by directing learners' attention toward the critical features of movement, thereby facilitating more efficient encoding of motor information into long-term memory. Furthermore, visual demonstrations provide learners with a concrete reference for accurate motor reproduction, helping them to replicate the skill with greater precision. From a motivational perspective, observing a competent model can also enhance the learner's self-efficacy and intrinsic motivation, fostering greater commitment and persistence throughout the learning process (5). However, our findings, which showed that visual modeling alone was less effective than the combined instruction, provide an important extension to Bandura's theory, as they suggest that mere observation may not be sufficient for achieving more stable skill representations in memory unless it is complemented by verbal cues. This finding emphasizing more strongly the simultaneous role of multi-channel cues in accelerating cognitive coherence and enhancing the effectiveness of learning.

Empirical evidence supports this perspective as well. For example, studies by Horn et al. (2007) and Mattar and Gribble (2005) have shown that observation enhances perceptual discrimination and strategic understanding, helping learners internalize the demonstrated performance (6, 7). This internal representation serves as a mental blueprint that guides the reproduction of the skill, aids in receiving feedback, and facilitates error correction. Moreover, recent neuroscientific findings suggest that observing movements activates the motor system covertly, even in the absence of physical execution (6, 7). This phenomenon, known as "early mediation," contrasts with "late mediation," which occurs only after actual movement performance. Such findings explain how observational practice can, under certain conditions, yield learning benefits comparable to physical practice (27). Visual models, therefore, not only present behavioral patterns but also provide learners with mental templates for imagery-based practice and performance refinement. This multi-faceted role of visual instruction highlights its importance in teaching perceptual-motor skills, particularly during the early stages of learning.

While the present study offers strong evidence for the efficacy of instructional modalities, it is limited to a specific motor skill and participant demographic. Moreover, the use of a non-probability (convenience) sampling method, while practical, may further limit the external validity of the findings. This sampling approach restricts the generalizability of the results primarily to individuals with similar characteristics (i.e., right-handed adolescent females with same-level skills) and may not extend to broader populations across different ages, genders, or skill levels. Future research should explore the differential impacts of these modalities across varying skill complexities, age groups, and contexts of expertise to generalize the findings further. Additionally, future studies are recommended that to examine the sequence effect of instructional modalities, such as comparing verbal-then-visual versus visual-then-verbal instruction orders, using a factorial design to further clarify optimal teaching strategies for motor skill learning.

Taken together, the findings of this study indicate that combining verbal and visual instructions creates a synergistic effect that simultaneously enhances cognitive processing and motor planning. The verbal component facilitates attentional focus and conceptual understanding of key elements of the skill, while the visual component strengthens perceptual-motor representations by offering concrete, observable models. This dual-channel approach leads to deeper, more stable learning and better skill transfer, as it engages multiple sensory modalities and reinforces mental encoding through both auditory and visual pathways. Theoretically, these results suggest a deeper integration between Bandura's observational learning model and Schmidt's "guidance hypothesis," indicating that the simultaneous use of visual and verbal channels can overcome the limitations of each and lead to more stable learning and better skill transfer. This theoretical integration could contribute to the development of new frameworks for motor skill training that emphasize multisensory interaction

and cognitive coherence. From an educational perspective, these results underscore the importance of utilizing multimodal instructional strategies in the teaching and practice of motor skills—particularly during adolescence, a critical period marked by rapid cognitive and motor development. Coaches, physical education teachers, and motor learning specialists are encouraged to integrate verbal and visual cues to create enriched learning environments that support both perception and execution of skills. When applied effectively, such combined instructional approaches can serve as a powerful tool for optimizing learning and ultimately enhancing sports performance among adolescents.

Authors' Contributions

Study concept and design: S.K. S. Data Collection: Z. G. Analysis and interpretation of data: S.K. S; Z. G. Drafting of the manuscript: S.K. S; Z. G. Critical revision of the manuscript for important intellectual content: S.K. S. Statistical analysis: S.K. S; Z. G. Administrative, technical, and material support: S.K. S; Z. G. Study supervision: S.K. S; F. H.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. The study was approved by the Ethics Committee of Shahid Rajaee Teacher Training University.

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