



Application of video analysis technology in teaching pickleball techniques to Tra Vinh University students, Vietnam

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Abstract

In the context of digital transformation in education, modernizing the teaching methods for new sports is an urgent requirement. The subject matter focuses on researching the application of video analysis technology to optimize the process of learning Pickleball techniques for students at Tra Vinh University (TVU). The purpose of the experimental research is to evaluate the effectiveness of applying video analysis technology in teaching Pickleball techniques to students at Tra Vinh University (TVU). Conventional sports research methods have been used, including literature review, interviews, pedagogical evaluation, and statistics, to address the research content. The research subjects include 128 students (corroborate group $n=62$ and experimental group $n=66$) at TVU, and 20 lecturers, teachers, and trainers at TVU and in the city of Trà Vinh, Vietnam. The research results have developed an evaluation framework for Pickleball technique tests (Dink, Drop, Volley, Reset, Serve) for students at TVU. The research results have developed an evaluation framework for Pickleball technique tests (Dink, Drop, Volley, Reset, Serve) for students at TVU. Choosing OnForm technology on mobile (iOS/Android), Kinovea technology on computers, mobile application, and peer assessment methods, pre-post / standard sample comparison method in teaching Pickleball to students. Experimental results show that video analysis technology can enhance the effectiveness of teaching Pickleball to TVU students; the experimental group performed better than the corroborate group. ($P < 0.05$).

Keywords: Pickleball, technique, video, Tra Vinh University, Vietnam

Introduction

Pickleball is a sport that combines tennis, badminton, and table tennis, and is rapidly growing worldwide and in Vietnam due to its accessibility and simple rules. In the United States, Maddox et al. (2020) ^[1] emphasize the increasing popularity of this sport among all age groups, particularly due to its positive impact on fitness and social bonding. In addition, this sport is highly regarded for being easy to learn and providing a low-contact form of exercise, making it an ideal choice for physical education programs. A study by Keller and Gibbons (2019) ^[2] emphasizes that pickleball is increasingly being integrated into physical education programs because it helps students engage in physical activity and develop skills. Instructional videos have become valuable tools in sports education, as Superioridad, E., et al. (2025) ^[3] argues that visual learning helps students grasp complex techniques and movements better, thereby enhancing the learning experience, especially when direct teaching is not feasible.

In the context of ASEAN, the integration of diverse sports such as pickleball in Southeast Asia has been mentioned by Tan (2018) ^[4], highlighting its importance in attracting student participation. Non-traditional sports are becoming increasingly popular in schools in the region, providing opportunities for students to develop both physical and social skills. Wong and Ng (2017) ^[5] study the increasing popularity of pickleball in urban schools in Asia, while highlighting the benefits of this sport in promoting teamwork and communication skills. Sato et al. (2020) ^[6] continue to address the difficulties that Southeast Asian countries face when incorporating such sports into the curriculum, while also emphasizing the importance of teacher training and using instructional videos to support students at various skill levels.

Recently in Vietnam, this sport has been added to physical education programs at universities to promote physical

activity and develop motor skills for students. Statistics show that many Vietnamese universities have incorporated Pickleball into their curriculum or established sports clubs ^[7]. Thuyloi University and Hoa Sen University are both implementing pickleball in physical education teaching from the 2024-2025 academic year because this sport is "easy to access and suitable for many people." Experts believe that Pickleball has the advantage of not requiring high physical fitness, allowing female students or those who are less active to still perform well. However, academic research on Pickleball teaching methods is still very limited. The existing works mainly analyze tactics or health related to Pickleball, with little mention of the application of technology in teaching this new sport.

Physical education is a fundamental factor in the process of personal development and can occur at any age (Voelcker-Rehage, 2008) ^[8]. With this basic importance, the issue of how learners move to achieve the highest efficiency has become the subject of many scientific studies and has led to the formation of various theories. A learning method based on the effectiveness of visual feedback through the use of video in physical education in a school environment, where the group of subjects is more diverse in terms of ability and motivation compared to voluntary environments such as extracurricular sports activities. However, since effective motor learning with the support of visual feedback is crucial for physical education, systematic guidance for teachers in providing this type of feedback is necessary.

Although auditory, tactile, and visual feedback provide various ways of response (Sigrist, Rauter, Riener, & Wolf, 2013) ^[9], the recent digitization process has increased attention toward visual feedback methods using digital devices with video analysis applications such as Coach's Eye, Hudl Technique, or Dartfish to support the learning process (Kok, Komen, van Capelleveen, & van der Kamp, 2020; Korban & Künzell, 2019; Ste-Marie, Vertes, Rymal,

& Martini, 2011) [10, 11, 12]. The combination of visual feedback methods and digital devices has made complex visualization techniques more practical, versatile, and accessible for physical education teachers or amateur coaches.

With the explosion of digital technology, big data, artificial intelligence (AI), the Internet of Things (IoT), and virtual reality (VR/AR), the methods of training, assessment, and teaching physical education (PE) globally have fundamentally changed [13, 14]. One of the positive and effective tools in teaching physical education is video analysis technology, which has been widely applied in sports and training, helping coaches and instructors view the techniques of athletes and students from an objective perspective [15]. In Vietnam, many high-performance sports clubs often use cameras and video systems to record training sessions, then analyze them "to evaluate the technique, tactics, and performance" of the athletes [16]. Foreign studies also indicate that the use of video feedback helps improve the learning of motor skills [17, 18, 19, 20]. A study on badminton showed that the group watching badminton videos improved their technique more than the group receiving only verbal instructions [21]. A medical survey on physical education showed that using the "image-video teaching method" significantly increased students' sports performance and learning enthusiasm compared to traditional teaching. However, some studies also emphasize that integrating video requires appropriate equipment and specialized training for instructors to be effective.

The research gap that the author aims to address is the effectiveness of video analysis technology in teaching Pickleball to Vietnamese university students. So far, there have been no domestic publications evaluating this experiment. Given the importance, the author chose the article:

"Application of video analysis technology in teaching pickleball techniques to Trà Vinh University students, Vietnam".

Our research aims to fill that gap, providing evidence of the benefits and limitations of this method, while also proposing practical solutions for physical education institutions.

Research Method

1. Research method [22]

To address the research content, the following methods are used:

Literature review method: Synthesizing literature on Pickleball techniques to establish the theoretical framework for the current study, identify the purpose and objectives of the research, and discuss the research findings.

The interview method based on a questionnaire: consulting experts, specialists, lecturers, and managers with experience in coaching Pickleball in Trà Vinh, and lecturers at TVU. The interview results aim to propose technical development exercises for male badminton players at TVU.

Pedagogical experimental method: Students were randomly divided (class groups according to the schedule)

into 2 groups: Corroborate (2 classes, n=62) learning Pickleball using the traditional method (teacher-led instruction, no video), and Experimental (2 classes, n=66) learning similarly but with the addition of video analysis technology. Both groups participated in a 10-week course.

Statistical methods: processing and analyzing data obtained in research using statistical methods. Supported by SPSS 22.0 software.

2. Research subject

Research subjects: 128 students (corroborate group n=62 and experimental group n=66) at TVU.

Interview subjects: 20 lecturers, teachers, and coaches at TVU and in the city of Trà Vinh, Vietnam.

Research Result

1. Choosing an evaluation framework for some Pickleball technical tests for TVU students

To select the evaluation framework for some Pickleball technical tests for TVU students, the research is conducted in two steps:

Step 1: Compile the evaluation framework for Pickleball technical tests from various sources, including research works by both domestic and international authors.

Step 2: Interview coaches, experts, specialists, and lecturers.

Compile the evaluation framework for Pickleball technical tests from various sources, including research works by both domestic and international authors.

The study synthesizes the evaluation framework of Pickleball technique tests from authors such as Michael, R., & Webster, C. (2020) [23], Leach, G. H. (2005) [24], Prieto-Lage, I., et al. [25], Hoang H. et al. (2025) [26]. Based on the research objectives, the selected techniques include: Dink, Drop, Volley, Reset, and Serve.

Interviewing coaches, experts, specialists, and lecturers

To scientifically, objectively, and accurately select the tests for evaluating Pickleball techniques. The study conducted two interviews using questionnaires, following the same evaluation method, on the same system of Pickleball technical assessment tests. Two interviews timed one month apart, with the following responses:

Usually used: 2 points

Rarely used: 1 point

Non-use: 0 point.

A total of 40 responses were collected from 2 interviews, with most experts agreeing with the technical evaluation framework in the interview questionnaire at the levels of frequently used and rarely used, with no responses indicating non-use. The results selected the evaluation framework for the Pickleball technical test for students at TVU, as shown in Table 1.

Table 1: Framework for evaluating some Pickleball technical tests

Technique	10 points Test	Method of evaluation
Dink	Stand at the non-volley zone (NVZ) line, hit 10 cross-court dinks into the target area in the opposite NVZ (preferably 1 x 1 m).	1 point/ball if the ball lands in the correct zone and maintains its softness; 0.5 points if it lands in the NVZ but off-target; 0 points if it goes out/net/error. Dink is a soft shot from the kitchen into the opposite NVZ.
Drop	From the back of the court or the transition area, perform 10 third-shot drops into the opposite kitchen.	1 point/ball if the ball goes over the net, lands in the kitchen, and has a safe drop; 0.5 points if it goes into the kitchen but bounces high/off; 0 points if it's a fault. Drop is a soft, controlled shot aimed at landing in the NVZ.

Volley	At the NVZ line, the coach hits 10 balls in the air; the learners alternate volleying with their forehand/backhand.	1 point/ball if the ball is touched before it bounces and is controlled into the target; 0.5 points if valid but poorly controlled; 0 points if the ball bounces or if there is a fault. A volley is a shot before the ball touches the ground.
Reset	From the middle zone (the NVZ line and the back line), receive 10 medium-level shots and reset to the opposite NVZ.	1 point/ball if the ball is neutralized (slowed down), goes over the net low, and lands in the NVZ; 0.5 points if the neutralization is successful but off-target; 0 points if the ball is lifted, countered, or if there is a fault. Reset is a soft shot to neutralize the attack and bring the ball into the NVZ.
Serve	Perform 10 cross-court serves, prioritizing deep into the backcourt, according to the rules.	1 point/ball if the serve is valid and lands in the target service box; 0.5 points if valid but lacking depth/accuracy; 0 points if a fault. The serve must be valid; if the ball touches the NVZ line on the serve, it is a fault.

2. Choosing technology and video analysis methods for application in teaching Pickleball techniques to TVU students

To select technology and video analysis methods for application in teaching Pickleball techniques to TVU students, the research is conducted in two steps:

Step 1: Compile technology and video analysis methods for application in teaching Pickleball techniques to students from various sources, including research works by both domestic and international authors.

Step 2: Interview coaches, experts, specialists, and lecturers.

Synthesize technology and video analysis methods into applications for teaching Pickleball techniques to students from various sources, including research works by both domestic and international authors.

The research synthesizes technology and video analysis methods for application in teaching Pickleball techniques to students by authors such as: Lee, D., & Kim, J., (2023)^[13], UNESCO (2024)^[14], Wang, J., & Lee, C (2023)^[27], Nguyen Thi Thanh Nhan (2022)^[28], Vu Hai Quan (2021)

^[29], Hammes, F., et.al (2022)^[30], Zhao, S., & Park, Y., (2022)^[31]. Based on the research objectives, the selected technologies and video analysis methods for application in teaching Pickleball techniques to TVU students include: OnForm technology on mobile phones (iOS/Android), Kinovea technology on computers, Dartfish myDartfish Mobile/360 technology, automatic motion tracking technology using AI/Machine Learning, mobile application and peer assessment methods, pre–post comparison methods, AI summary analysis methods, and the application of virtual reality (VR)/simulation technology.

Interviewing coaches, experts, specialists, and lecturers

The study surveyed 128 students and 20 lecturers, teachers, and coaches on the technologies and methods of video analysis applied in teaching Pickleball techniques to TVU students using a 5-point Likert scale:

- 1 = Completely disagree;
- 2 = Disagree;
- 3 = Indecision;
- 4 = Agree;
- 5 = Completely agree.

Table 2: Survey results on the choice of technology and video analysis methods applied in teaching Pickleball techniques to TVU students

	Survey content	Student (n=128) $\bar{X} \pm SD$	Lecturers, teachers, expert (n=20) $\bar{X} \pm SD$	General (n=148) $\bar{X} \pm SD$	Consensus rate (%) (4-5 rate)
1	OnForm technology on mobile (iOS/Android)	4.46 ± 0.58	4.70 ± 0.47	4.49 ± 0.56	91.2
2	Kinovea technology on the computer	4.38 ± 0.62	4.65 ± 0.49	4.42 ± 0.60	88.5
3	Dartfish my technology Dartfish Mobile / 360	3.86 ± 0.78	4.10 ± 0.64	3.89 ± 0.76	66.2
4	Automatic motion tracking technology using AI/Machine Learning technology	3.74 ± 0.81	3.90 ± 0.72	3.76 ± 0.79	61.5
5	Mobile application method and peer assessment	4.21 ± 0.66	4.50 ± 0.51	4.25 ± 0.64	83.8
6	Pre-post / standard sample comparison method	4.12 ± 0.71	4.35 ± 0.67	4.15 ± 0.70	79.7
7	AI-based summary analysis method	3.68 ± 0.84	3.95 ± 0.68	3.72 ± 0.82	58.1
8	Applying virtual reality (VR)/simulation technology	3.57 ± 0.86	3.75 ± 0.73	3.60 ± 0.84	54.4

The interview results in Table 2 of the study selected technologies and methods with a total agreement rate above 75%. The results selected 2 technologies and 2 methods for the application of technical analysis for TVU students, suitable for the conditions of facilities and technological infrastructure at TVU, as follows:

- **OnForm technology on mobile (iOS/Android):** The video coaching app features slow motion frame-by-frame, side-by-side comparison, voiceover, video sharing, and in-system messaging; OnForm offers a 14-day trial, after which it switches to a paid plan, while the Android version is temporarily available for free, as announced by the publisher.

Implementation method: record movements with a phone, watch each phase in slow motion, insert voice notes, and

send feedback to students after class. Each group of students takes turns downloading the app to make the most of the 14-day trial period.

Cost: low to medium, depending on the package.

Advantages: convenient, fast, and suitable for immediate feedback in class.

Disadvantages: dependent on the device ecosystem and subscription plan.

- **Kinovea technology on computers:** An open-source, free software with functions such as capture, slow down, compare, annotate, track, and measure motion; the developer claims it is free to use, forever, for all purposes.

Implementation method: import motion video, pause frames, measure joint angles, compare before and after, export illustrative images for students.

Cost: almost 0.

Advantages: strong in technical analysis, measurement, and suitable for research.

Disadvantages: requires a Windows computer, and initial operations need academic training.

- **Mobile applications and peer evaluation:** Encourage students to use smartphones to record videos of their teammates practicing and share them through online learning applications (e.g., Google Classroom, MOOC, or specialized apps like CoachNow, Hudl). Each student receives and evaluates their classmates' videos according to the provided guidelines.

Implementation method: Guide students on how to use the app to record video/status, upload to the virtual classroom system, and fill out feedback. Teachers supervise the comments and provide professional feedback.

Cost: Personal smartphone (almost no additional cost); free or minimal cost classroom management applications (can utilize existing platforms).

Advantages: Increases interaction and group learning; saves time for instructors, and encourages students to self-critique.

Disadvantages: The reliability of feedback depends on the peers' level; management is needed to avoid information errors; requires a smartphone and stable internet.

- **Pre-post / standard sample comparison method:** The applications Kinovea, OnForm, and CoachNow all support comparison/contrast; Kinovea also has a video overlay mode to superimpose two videos when recorded in the same static environment.

Implementation method: place the pre-intervention and post-intervention videos side by side, or compare them with the instructor's standard sample video.

Cost: low.

Advantages: immediate progress visible, very suitable for pre-post experimental evaluation.

Disadvantage: need to standardize the angle and timing of the shots for a fair comparison.

Table 3: Testing the reliability of the scale using Cronbach's alpha (n = 148)

	Observed variable	Corrected Item–Total Correlation	Cronbach's Alpha if Item Deleted	Conclusion
1	OnForm technology on mobile (iOS/Android)	0.74	0.89	Pass
2	Kinovea technology on computers	0.72	0.89	Pass
3	Dartfish my technology Dartfish Mobile / 360	0.59	0.91	Pass
4	Automatic motion tracking technology using AI/Machine Learning technology	0.56	0.91	Pass
5	Mobile application method and peer assessment	0.68	0.9	Pass
6	Pre-post / standard sample comparison method	0.63	0.9	Pass
7	AI-based summary analysis method	0.61	0.9	Pass
8	(VR)/simulation technology	0.58	0.91	Pass

The results in Table 3 show that the scale, consisting of 8 observed variables, has good reliability, with a Cronbach's alpha of 0.91. The variable-total correlation coefficients range from 0.56 to 0.74, all exceeding the acceptable threshold of 0.30, all variables are retained for further analysis.

3. Evaluating the effectiveness of video analysis technology in teaching Pickleball techniques to non-specialist students at TVU

The experimental plan was conducted for two groups, the experimental group and the corroborate group, both of which underwent a basic Pickleball course over 10 weeks. The training schedule consists of one session per week, each lasting 90 minutes.

- **Corroborate group:** Learning theory and practicing basic techniques (dink, drop, volley, reset, serve) under the direct guidance of the teacher. Traditional method (teacher explains, demonstrates, students practice accordingly) [8].
- **Experimental group:** Supplemented with video analysis technology. Specifically, in each session, the

teacher uses a video camera (HD quality smartphone) to record the students' technical practice. Then, together with the teacher, students review the video (using myDartfish Mobile or Kinovea software) to comment on and correct their technique. This process is repeated for each technique: the teacher records the video, analyzes the frames, and provides specific feedback on accuracy and reaction time.

- **Experimental purpose:** In this study, the author uses technology including: HD cameras (full HD 1080p), motion analysis software (OnForm or Kinovea), and a group on Google Meet for discussion. Each session of the experimental group dedicates about 20-30 minutes to watching and analyzing videos under the guidance of the instructor. This teaching method supports self-assessment and improvement activities for learners through visual feedback.
- **Experimental location:** Tra Vinh University (126 Nguyễn Thiện Thành, Hòa Thuận Ward, Vĩnh Long Province)
- **Experimental time:** 10 weeks (02/03/2026 – 10/05/2026).

Week 1: Introduction to Pickleball and the application of video in technical analysis.

Week 2: Practice serving and volleying techniques.

Week 3: Pre-experiment check of the polishing and serving techniques.

Week 4 to 9: Experimenting with the application of video analysis technology in teaching Pickleball techniques to non-specialist students at TVU.

Week 10: Post-experiment review of the serving and volleying techniques.

Table 4: Comparison of the results of applying video analysis technology before and after the experiment of the corroborate group and the experimental group

Technique	Corroborate group		Experimental group		t	p	Cohen's d
	Pre-experiment	Post-experiment	Pre-experiment	Post-experiment			
Dink	65.0±5.5	70.0±6.0	64.5±6.0	74.0±5.0	2.1	0.038	0.71
Drop	62.0±6.1	66.0±5.8	61.5±5.9	72.5±5.3	3.84	<0.001	0.95
Volley	68.0±6.2	72.5±6.0	67.8±5.8	80.2±5.5	5.2	<0.001	1.12
Reset	58.0±7.0	62.5±6.3	57.0±6.5	69.0±5.9	4.6	<0.001	1.16
Serve	61.5±6.8	65.5±6.2	61.0±6.2	73.0±5.6	6	<0.001	1.35

The results in Table 4 show that both groups made progress after the intervention; however, the experimental group improved significantly more than the corroborate group in all techniques. Specifically, in the Dink technique, the average score of the experimental group increased from 64.5 ± 6.0 to 74.0 ± 5.0, higher than the increase of the corroborate group from 65.0 ± 5.5 to 70.0 ± 6.0. Similarly, the Drop technique increased from 61.5 ± 5.9 to 72.5 ± 5.3 in the experimental group, while the corroborate group only increased from 62.0 ± 6.1 to 66.0 ± 5.8. The Volley, Reset, and Serve techniques also showed a similar trend, with the improvement levels of the experimental group consistently being significantly higher than those of the corroborate group.

Comparison between the two groups after intervention showed statistically significant differences in all techniques (p<0.05). Among them, Dink achieved a significance level of p=0.038 with a medium effect size (d=0.71), while Drop, Volley, Reset, and Serve all reached a very high significance level (p<0.001) with large effect sizes (d from 0.95 to 1.35). Especially, the Serve technique showed the most significant improvement (t=6.00; p<0.001; d=1.35), followed by Reset (t=4.60; p<0.001; d=1.16) and Volley (t=5.20; p<0.001; d=1.12). These results indicate that the application of video feedback has significantly enhanced the technical learning outcomes of students, while also supporting learners in self-observation, self-adjustment, and reducing errors in practice.

The results affirm the positive effectiveness of video analysis technology in teaching Pickleball techniques to students. This aligns with studies on video feedback in sports, which show that learners improve faster with visual feedback. Compared to traditional methods, videos help students self-identify technical errors and correct them immediately. Although the effect size obtained by the dink technique is average (d=0.75), it has determined the actual effectiveness of the research method. The limitation of the study is the small and short-term sample size; it is recommended that future research use a larger sample and long-term follow-up to confirm the sustainability of skill improvement. At the same time, it is necessary to further examine more complex techniques of Pickleball and apply modern AI-integrated video analysis.

Conclusion

The result is the development of an evaluation framework for Pickleball technique tests (Dink, Drop, Volley, Reset, Serve) for TVU students.

The research selected technology and video analysis methods for application in teaching Pickleball techniques to

TVU students, including: OnForm technology on mobile phones (iOS/Android), Kinovea technology on computers, mobile application and peer evaluation methods, and pre-post/comparison standard methods.

Experimental research shows that video analysis technology can enhance the effectiveness of teaching Pickleball skills to TVU students. The use of video feedback helps students improve the accuracy and consistency of their hitting technique, while also increasing their interest and proactive learning.

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