Reaction speed ability of pencak silat athletes: objective measurement using tz quick-light reaction training

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ABSTRACT

Problems: Pencak silat is a traditional Indonesian martial art that requires optimal mastery of biomotor components, especially reaction speed, which plays an important role in achieving performance during competition. However, reaction training is often difficult to implement due to limited facilities, making it challenging for coaches and athletes to conduct objective evaluations. The novelty of this study lies in the use of the TZ Quick-Light Reaction Training (TZ Quick-LRT) tool as a technology-based instrument to objectively measure athletes' reaction speed. **Purpose:** This study aimed to objectively measure the reaction speed of pencak silat athletes using the TZ Quick-LRT tool. **Methods:** The research employed a descriptive quantitative method involving 20 athletes from the pencak silat student activity unit at Universitas Pendidikan Indonesia. Each athlete completed two measurement sessions, each consisting of eight random LED visual stimuli. The average reaction times were analyzed using descriptive statistics in SPSS version 21 to obtain minimum, maximum, mean, and standard deviation values. **Results:** The fastest reaction time recorded was 0.712 seconds, while the slowest was 2.842 seconds. Descriptive analysis revealed that the mean reaction time in the first session was 1.510 seconds (SD = 0.238), and in the second session it improved to 1.461 seconds (SD = 0.243), indicating better responses in the second measurement. **Conclusion:** The TZ Quick-LRT tool proved to be capable of measuring pencak silat athletes' reaction speed objectively, accurately, and in a data-based manner. The contribution of this research lies in utilizing sports technology as both a training medium and a performance evaluation instrument. The limitation of this study is the tool's lack of portability. Future research is suggested to develop a more practical device and examine its effectiveness in long-term training programs.
Keywords: Reaction Speed, Pencak Silat, Objective Measurement, Visual Training, TZ-Quick-LRT.

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Introduction

Pencak silat is a traditional Indonesian martial art that has been known since ancient times. Over time, its techniques have become highly diverse, including basic stances, punches, kicks, and scissors. Each of these techniques has specific purposes when performed in pencak silat competitions (Alfin et al., 2022). In matches, athletes perform kicking, punching, and blocking techniques to earn points (Aldinatama & Siregar, 2023). Mastery of pencak silat techniques must be supported by optimal biomotor components to ensure that young athletes can enhance their performance both during training and competition. Among these components, speed is as crucial as strength in pencak silat. Reaction speed, as one aspect of speed, is an essential component that must be developed to help athletes achieve their training goals.

Speed plays an important role in achieving success across various sports (N. Ihsan, 2018). Sports are systematic bodily movements consciously carried out by individuals (Khotimah et al., 2023). Essentially, sports

are an inseparable part of education, aiming to improve physical, mental, emotional, and social health (Purnamasari, 2017). Reaction speed (quickness) is one of the physical components required by athletes. It can be categorized into three types: visual, auditory, and kinesthetic. Generally, athletes tend to focus on training physical components such as speed and agility. However, reaction speed also needs to be improved to enhance performance, as better performance positively affects mental, physical, and emotional conditions.

Nevertheless, reaction training is often difficult to implement due to limited facilities, making it challenging for coaches and athletes to specifically train reaction speed. According to Jayanto et al., (2022), efforts to improve athletic performance should not be limited to basic technical training; athletes must also adapt to advances in science and technology. It is highly recommended that young athletes engage in training procedures that incorporate both general and specific stimulus training to achieve long-term performance goals (Calvo, 2022). For instance, the investigation of specific kicking techniques can be conducted using a reaction time paradigm, where athletes perform kicks in response to stimuli (Ervilha et al., 2020). Without training in this component, athletes may struggle to maintain focus during competitions, which is a significant disadvantage.

When facilities to support reaction speed training are unavailable, this biomotor component becomes difficult to improve. The advancement of sports technology has contributed significantly to the development of athletes in Indonesia (Syakur et al., 2017). One example is the TZ Quick-Light Reaction Training device, designed to measure athletes' visual reactions to light stimuli. Visual reaction is often crucial for pencak silat athletes. Neural signal transmission speed can also differentiate between types of athletes depending on their sport-specific demands. Athletes requiring greater muscular strength tend to display different transmission patterns compared to endurance-oriented athletes (Castellar et al., 2019). Since pencak silat athletes require high muscular strength, their response signals must also be enhanced through reaction speed training.

The ability of an athlete to quickly recognize and respond to various stimuli is a key factor in achieving optimal performance, including in pencak silat (Milic et al., 2020). To ensure that reaction speed develops systematically, objective and standardized measurement instruments are required. The use of technology-based tools in performance evaluation allows for more efficient and accurate measurements that can also be conducted independently. The introduction of devices such as the TZ Quick-Light Reaction Training (TZ Quick-LRT) makes it possible to measure visual reactions through consistent light stimuli and analyze the data quantitatively. Technological innovations in cognitive-motor measurements now include electronic stimuli such as video, virtual reality, visual occlusion devices, and LED lighting systems, all of which are designed to expand the possibilities of performance evaluation in various sports contexts (Arede et al., 2021).

The application of science and technology (IPTEK) in sports not only supports training but also plays a vital role in evaluating athlete performance, particularly in the measurement of biomotor abilities (Aljupri, 2023). The TZ Quick-LRT is a technology-based innovation designed to objectively measure reaction speed. It is equipped with four differently colored LED indicators programmed to light up randomly, providing visual stimuli that trigger motor responses from athletes. Using time sensors, the device records how long it takes for athletes to respond to the illuminated LED. Reaction speed to visual stimuli is a crucial element in combat sports such as pencak silat (Sant'Ana et al., 2017), where athletes must quickly identify and respond to opponents' movements. Athletes with faster reaction times gain an advantage in anticipating attacks and executing effective counter-responses.

Previous research has reported that the BATAK Pro training device is an interactive tool designed to improve athletes' reaction speed by training rapid responses to visual stimuli. BATAK Pro can be understood as a complementary method for enhancing motor performance in young athletes (Arede et al., 2021). It is specifically designed to train reaction, hand-eye coordination, and stamina under simulated conditions. These findings strengthen the proposition that visual skills can be trained and developed using electronic devices. Countries that integrate technology into sports training tend to achieve better performance, as technologically advanced devices offer higher accuracy compared to manual tools (Pakpahan et al., 2024).

Based on the above discussion, this study focuses on objectively measuring the reaction speed of pencak silat athletes using the TZ Quick-Light Reaction Training (TZ Quick-LRT) device. This device is designed to provide light stimuli and automatically record athletes' reaction times. The purpose of this measurement is to provide concrete data on reaction speed, which has rarely been evaluated in a standardized manner in pencak silat. Reaction speed is an essential biomotor component that enhances body coordination, particularly in responding to opponents' movements quickly and accurately. With this tool, coaches can utilize data-driven evaluations to design more specific and athlete-oriented training programs.

Methods
Research Design
This study employed a descriptive quantitative method with the aim of objectively measuring athletes' reaction times using the TZ Quick-LRT device. The descriptive quantitative method is a research approach intended to describe or explain phenomena as they are, based on numerical data obtained from respondents or research subjects (Fraenkel, 2019). This approach was considered appropriate because it allows for direct numerical data collection based on athletes' actual reactions to stimuli.

Time and Location of the Study
The research was conducted at the Pencak Silat Student Activity Unit (UKM) and the Gymnasium of Universitas Pendidikan Indonesia (UPI) in July 2025.

Research Subjects
The subjects of this study were 20 athletes from the Pencak Silat Student Activity Unit (UKM) at UPI.

Research Procedure
Each athlete underwent two sessions of visual reaction time measurement using the TZ Quick-Light Reaction Training (TZ Quick-LRT) device. Each session consisted of eight visual stimuli in the form of randomly lit LEDs, which athletes were required to respond to as quickly as possible. Thus, each athlete produced a total of 16 reaction time data points.

Research Instrument
The instrument used in this study was the TZ Quick-Light Reaction Training (TZ Quick-LRT), a device specifically designed to objectively measure athletes' reaction times to visual stimuli.

Data Collection Technique
Data were collected by recording each athlete's reaction time in response to randomly lit LED stimuli on the TZ Quick-LRT device. The reaction time data were recorded in seconds.

Data Analysis Technique
For each session, the average reaction time was calculated to obtain two representative scores: the average of the first session and the average of the second session. These average scores were then analyzed using descriptive statistics through SPSS version 21, producing information on the mean, minimum, maximum, and standard deviation. The results of this analysis were used to describe the visual reaction speed ability of pencak silat athletes objectively, based on the measurements from two separate sessions.

Result
The measurement results of the reaction speed of pencak silat athletes using the TZ Quick-Light Reaction Training (TZ Quick-LRT) are presented in tabular form to facilitate interpretation. The first measurement was conducted using eight randomized visual stimuli for each athlete, as shown in Table 1.

Table 1. First Measurement Data

Name	R1	R2	R3	R4	R5	R6	R7	R8
NF	1,403	1,412	1,416	1,423	1,412	1,423	2,122	2,122
DA	2,122	2,132	2,112	2,131	1,413	1,423	1,412	1,413
RIS	2,132	1,422	2,830	2,113	1,424	1,422	1,422	1,423
LF	2,132	1,423	1,422	1,422	2,132	2,143	2,133	1,422
JK	1,423	1,422	1,402	1,402	1,403	1,402	2,132	0,713
AFS	0,714	1,423	1,424	0,714	1,423	0,714	0,713	1,424
SA	1,424	2,133	1,422	1,423	1,423	2,842	2,132	1,412
AMP	2,132	1,424	2,132	1,422	2,132	1,432	1,423	0,713
MI	1,423	0,713	1,423	1,422	2,132	0,713	0,714	0,712
GA	1,423	2,133	1,422	2,133	0,714	0,713	1,422	2,132
FS	0,713	0,712	1,402	1,424	2,132	2,131	0,712	0,714
KT	1,423	1,223	1,412	2,122	1,413	1,423	2,132	2,83
MRDS	1,423	0,712	1,402	2,132	0,714	0,713	1,423	0,714
SF	1,422	1,422	2,112	2,131	2,132	0,712	0,714	1,423

IR	2,132	1,423	2,132	1,423	1,402	0,714	2,132	1,403
KNU	1,422	0,713	1,242	1,402	1,423	0,712	2,132	1,422
NND	1,423	0,714	1,424	2,113	1,402	1,403	2,133	1,422
RV	2,132	1,402	1,423	2,842	2,132	0,714	1,422	2,133
SM	1,403	1,416	1,412	2,122	2,131	1,413	1,412	1,422

Table 1 presents the objective data of reaction time measurements of pencak silat athletes in the first trial using the TZ Quick-Light Reaction Training (TZ Quick-LRT). The measurements indicate that the fastest recorded reaction time was 0.712 seconds, while the slowest reaction time reached 2.842 seconds. The second measurement data will be presented in Table 2.

Table 2. Second Measurement Data

Name	R1	R2	R3	R4	R5	R6	R7	R8
NF	0,714	1,423	1,424	0,714	1,423	0,714	0,713	1,424
DA	1,423	2,132	2,112	2,131	1,413	1,423	1,412	1,413
RIS	1,423	1,422	2,830	2,113	1,424	1,422	1,422	1,423
LF	1,422	1,423	1,422	1,422	2,132	2,143	2,133	1,422
JK	2,132	1,422	1,402	1,402	1,403	1,402	2,132	0,713
AFS	1,422	1,423	1,424	0,714	1,422	1,403	1,402	1,424
SA	1,423	2,133	1,422	1,423	1,423	1,423	0,714	1,412
AMP	2,132	1,424	2,132	1,422	1,422	1,423	2,842	0,713
MI	1,403	0,713	1,423	1,422	1,423	2,132	1,432	0,712
GA	1,423	2,133	1,422	2,133	2,133	2,132	0,713	2,132
FS	0,713	0,712	1,402	1,424	1,424	0,714	0,713	0,714
KT	1,423	1,223	1,412	2,122	0,713	2,132	2,131	2,83
MRDS	1,423	0,712	1,402	2,132	2,133	1,413	1,423	0,714
SF	1,422	1,422	2,112	2,131	0,712	0,714	0,713	1,423
IR	2,132	1,423	2,132	1,423	1,223	2,132	0,712	1,403
KNU	1,422	0,713	1,242	1,402	0,712	1,402	0,714	1,422
NND	1,423	0,714	1,424	2,113	1,422	1,423	0,712	1,422
RV	2,132	1,402	1,423	2,842	1,423	1,402	1,403	2,133
SM	1,403	1,416	1,412	2,122	0,713	2,132	0,714	1,422

Table 2 shows the results of the reaction time measurements of pencak silat athletes in the second trial using the TZ Quick-Light Reaction Training (TZ Quick-LRT). The data indicate that the fastest recorded reaction time was 0.714 seconds, while the slowest reaction time was 2.842 seconds. The measurements were conducted in two sessions, each consisting of eight stimuli, and then averaged to produce the reaction time score for each athlete. The processed data are presented in Table 3.

Table 3. Results of Descriptive Analysis

Variable	N	Min	Max	Mean	Std. Deviation
Sesi 1	20	1,001	1,779	1,51095	0,237952
Sesi 2	20	0,977	1,778	1.46125	0,243477

Table 3 presents the results of the descriptive analysis of the visual reaction time measurements of pencak silat athletes using the TZ Quick-Light Reaction Training (TZ Quick-LRT) across two sessions. In

the first session, the average reaction time was 1.510 seconds, with a standard deviation of 0.238, the fastest time recorded at 1.001 seconds, and the slowest at 1.779 seconds. Meanwhile, the second session showed an average reaction time of 1.461 seconds, with a standard deviation of 0.243, the fastest time at 0.977 seconds, and the slowest at 1.778 seconds.

Discussion

This study aimed to objectively measure the reaction speed of pencak silat athletes through two measurement sessions using the TZ Quick-Light Reaction Training (TZ Quick-LRT). The findings demonstrate that the device is capable of recording reaction times objectively and systematically. This is consistent with Witte et al., (2022), who emphasized that reaction speed training is more effective when conducted in a measurable manner and produces quantitative data for each athlete. Efforts to improve athletic performance should not rely solely on technical training but must also incorporate advancements in science and technology (Jayanto et al., 2022). Thus, the use of training aids that can record objective data provides a valuable solution in modern training.

The accuracy of the device in recording each reaction to eight stimuli per session proves that it can serve not only as a training medium but also as a tool for real-time performance evaluation. This aligns with Kuo et al., (2020), who stated that training systems capable of accurately recording reaction times contribute significantly to monitoring and enhancing athlete performance. Reaction speed training conducted without objective measurement tools makes it difficult for coaches to evaluate athletes' progress. Therefore, the TZ Quick-LRT provides visual light stimuli with automatically recorded reaction times. Reaction speed training that yields measurable outputs is believed to provide more accurate evaluations of athletes' abilities (Witte et al., 2022). This system supports coaches in systematically recording and monitoring athletes' response progress (Kuo et al., 2020).

The variety of data obtained from each athlete shows that reaction time can be influenced by factors such as mental readiness, focus, and decision-making speed. As explained by Haff, (2016), agility and quick reactions are closely related to situational cognitive aspects. In this regard, the use of the TZ Quick-LRT also trains athletes' psychological aspects, as the randomized light stimuli demand rapid reactions similar to unpredictable competition situations. This device supports data-driven training principles, providing real-time feedback that can enhance athletes' performance and situational awareness (Wijewickrema et al., 2017). In addition, it can also be used for testing and evaluation purposes, as it provides structured training outcome data.

Furthermore, the use of this device offers an interactive training experience and can be developed into light-based game formats. This is in line with Cariati et al., (2025), who found that interactive training systems with visual stimuli and game-based tasks significantly improve training outcomes. However, although the data show that the device is reliable in recording reaction times, there remains considerable variability among stimuli and between athletes, as reflected in the standard deviation values of both sessions. This variability may be attributed to the randomized lighting stimuli, leading to inconsistent movements and readiness among athletes.

In practice, the use of this device also considers psychological factors. Randomized stimulus simulations can improve athletes' focus and mental readiness. When a specific light color appears, athletes are instructed to respond with a particular technique, such as a punch or kick. This situation mimics competition conditions that require quick and accurate decisions. Such training can strengthen situational cognitive aspects and reduce competitive anxiety (Rizqullah et al., 2025). From a pencak silat technical perspective, this training is well-suited to sharpening various attack techniques, particularly kicks, which have high value in competitions (Diono & Jatmiko, 2021). The accuracy and speed of kicks can be systematically trained using this device, while also emphasizing body coordination (Bakhtiar & Irawan, 2023). This demonstrates that the TZ Quick-LRT can serve as part of a comprehensive training system, rather than being limited to a reaction training aid.

In the context of modern training, the use of technology such as the TZ Quick-LRT represents a scientific and data-driven approach (F. Ihsan et al., 2023). With its capability to objectively record reaction times, training with this device supports the principles of technology- and motor-based physical education. Beyond serving as a training medium, it can also be used for enjoyable activities through game-based tasks, which have been shown to increase engagement and training outcomes (Cariati et al., 2025).

Nevertheless, this training tool still has several technical limitations, such as dependence on a wall mount and the need for direct power supply, which prevents it from being fully portable. Even so, this is in line with Shan (2020), who noted that although technical devices may have limitations, they remain effective in monitoring and supporting training decision-making.

Conclusion

Based on the measurement results and data analysis, it can be concluded that the TZ Quick-Light Reaction Training (TZ Quick-LRT) device is capable of measuring the reaction speed of pencak silat athletes

objectively and accurately. The average reaction time in the second session was better compared to the first session, indicating an improvement in visual responses after repeated stimuli. The presence of this device contributes significantly to pencak silat training, not only as a reaction training tool but also as a data-based performance evaluation instrument. It supports the principles of modern training that integrate technology, interactivity, and standardized measurement. Although the device has technical limitations in terms of portability, its effectiveness in recording reaction times remains high. Therefore, the use of the TZ Quick-LRT is strongly recommended in pencak silat training, particularly for enhancing visual reaction speed, which is crucial in competition.

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