Learning Innovation With The Biomechanics Analysis Application (Kinovea Software) To Develop Skills Short Distance Running (100 M) PKO FIK UNIMED Students

Putra Arima[1], Asep Prima[2], Yan Indra Siregar[3], Dicky Edwar Daulay[4]

putraarima@unimed.ac.id

Universitas Negeri Medan[1,2,3,4]

Abstract. This study aims to describe the analysis of athletic skills in the 100 meter sprint race in PKO FIK UNIMED students. The data analysis technique in this study used quantitative descriptive analysis with percentages. The results of the analysis of athletic skills movements in the 100 meter sprint event showed that there were 3 students with a percentage of (11,54%) who have 100 Meter Sprint Running Skills in the very good category, 4 students with a percentage (15,38%) who have 100 Meter Sprint Running Skills in the good category, 12 students with a percentage (46,15%) who have 100 Meter Sprint Running Skills in the medium category, 2 students with a percentage (7,09%) who has 100 Meter Sprint Skills in the very poor category. So, of the 5 categories, the largest percentage is 12 students in the medium category.

Keywords: Motion Analysis, Skills, Athletics

1. Introduction

Physical education is an important component in the academic curriculum which aims to develop students' motor skills and physical performance competencies. Athletic learning, especially short distance running (100 m), requires the implementation of an effective instructional approach to improve technique and comprehensive running performance results (Podungge et al., 2024). The 100 m is a sprint event that requires a combination of speed, acceleration and biomechanical efficiency of movement, so appropriate learning strategies are very important in physical education to create competent runners and understand the factors that influence their running performance. In athletics, short distance running really prioritizes speed, because victory in these events is if the runner manages to record a shorter time than his opponents, in other words a runner must reach the finish line first than his opponents. Getting speed is not easy, because there are many supporting factors to get maximum speed from an athlete's running.

However, in practice, the process of learning 100 meter sprint skills is often carried out using conventional methods which rely heavily on verbal instructions and direct observation by lecturers. This approach tends to be subjective and limited in providing detailed feedback on student movement errors. As a result, students may have difficulty understanding complex biomechanical concepts and correcting their running technique effectively.

According to Pietraszewski et al. (2025) in a meta-analysis of sprint biomechanics, the study of running biomechanics integrates aspects of the physics and mechanics of muscle movement and their interaction with athlete performance, discussing how kinetic and kinematic principles are applied to scientifically evaluate sprint technique. In the context of sprint training, biomechanical analysis provides quantitative information about aspects such as joint angles, stride length, and speed of each movement phase (Rahadian, 2018). Understanding biomechanics is very important because it can help coaches and students to evaluate running technique objectively, identify movement weaknesses, and design more effective training programs based on measurable data.

As technology advances, the use of video analysis software has become an efficient method for evaluating athlete movements in sports learning and training (Natanael Tumanggor et al., 2025). One software that is widely used in sports is Kinovea software, which allows frame-by-frame motion analysis and measurement of biomechanical parameters from running videos. With features such as joint angle measurements and precise timing, Kinovea supports teachers or coaches in providing accurate visual feedback to improve individual athletic technique.

Learning innovation that utilizes Kinovea software is an approach that brings athletic learning from traditional methods to the use of digital technology. In research using Kinovea, the aim is to analyze each phase of the students' 100 m run and provide data-based feedback about their movement performance (Rahadian, 2018). This can increase student involvement in learning because they can see the results of their own movement analysis visually and understand the technical aspects that need to be improved, so that learning becomes more effective and focused.

This research contributes to the development of innovative learning models in physical education and sports that are integrated with technology-enhanced learning. By obtaining a clear biomechanical analysis of each running phase using Kinovea, students can significantly improve their short distance running skills and understand the relationship between technical movements and their physical performance results (Rahadian, 2018). Apart from that, the use of technology in learning can be the basis for further research in developing other sports performance evaluation tools. It is hoped that the findings of this research will contribute empirical evidence regarding the effectiveness of technology-based athletic learning innovations and provide practical insights for improving sprint teaching in higher education contexts.

2. Methods

This research uses a quantitative descriptive method, which aims to systematically, factually and objectively describe the 100m running skills of PKO FIK UNIMED students. The quantitative descriptive method allows researchers to measure and present data in the form of numbers, such as the percentage of students who are in certain skill categories (Sugiyono, 2020). According to Creswell (2014), this approach is effective when the research objective is to describe existing conditions and provide a general description of the phenomenon being studied.

The research subjects consisted of PKO FIK UNIMED students who took athletics courses, with a total of 27 students. Subject selection was carried out using total sampling, so that all students who met the research criteria were analyzed. This approach ensures that the data obtained is

representative of the class's student population (Fraenkel, Wallen, & Hyun, 2019). The inclusion criteria were students who participated in all 100m sprint training sessions, while the exclusion criteria were students who experienced injuries or did not participate in full training sessions.

Data was collected through observation of 100m running movements using Kinovea biomechanical analysis software, which allows precise and visual movement measurements. The data collection procedure includes several stages:

1. Students run 100m according to sprint technique standards.

2. Movement is recorded using a camera with a high frame rate to ensure detailed movements are recorded.

3. The video is analyzed using Kinovea, including measurements of joint angles, stride length, acceleration phase duration, and sprint speed.

4. Each movement is analyzed and compared with standard 100m running techniques to determine the student's skill category (Rahadian, 2018; Natanael Tumanggor et al., 2025).

The use of Kinovea as a biomechanical analysis tool is supported by recent research, which shows that this software is effective for analyzing athletes' movements frame-by-frame, providing objective feedback, and making it easier to identify technical errors (Pietraszewski et al., 2025).

Data Collection Techniques and Data Analysis Techniques

Data were analyzed using quantitative descriptive analysis with percentages, which aims to determine the distribution of students based on 100m running skill categories: very good, good, moderate, poor and very poor. Data analysis steps include:

1. Group the results of observations and movement measurements into skill categories.

2. Count the number of students in each category.

3. Convert the number of students to a percentage of the total subjects.

4. Present data in tables or graphs to facilitate interpretation (Creswell, 2014).

The results of the quantitative analysis allow researchers to provide an objective picture of students' running abilities and identify areas that need to be improved through technology-based learning.

For data validity, movement measurements were carried out by trained observers, using standard international 100m running techniques. Measurements were analyzed more than once to ensure consistency.

For reliability, each video was analyzed independently by two different observers and the results were compared to minimize observational bias (Fraenkel et al., 2019). In addition, the use of

Kinovea increases the accuracy of measuring angles and duration of movement, so that the data obtained is more objective and reliable.

This research method integrates traditional athletic observation approaches with Kinovea-based technology analysis, resulting in measurable, objective and visual data. This approach not only describes students' abilities factually, but also provides a basis for designing more effective 100m running learning strategies.

3. Results And Discussion

The research results were obtained through analysis of the 100 meter short distance running motion of PKO FIK UNIMED students using Kinovea software as a biomechanical analysis instrument. The analysis focused on the main kinematic parameters that represent the quality of sprint technique, namely joint angles (hip, knee and ankle), stride length, acceleration phase duration, and speed stability in the maximum speed phase. Each parameter is analyzed frame-by-frame and compared with standard 100 meter sprint techniques.

Quantitatively, the analysis results show that the distribution of students' sprint running skills varies between categories. The percentage distribution of students' 100 meter running skills can be seen in Figure 1.
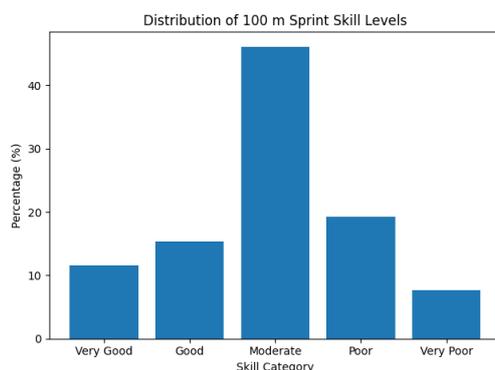

Fig 1. Distibution of 100 m Sprint Skill Levels

Based on Figure 1, it is known that 3 students (11.54%) are in the very good category, 4 students (15.38%) are in the good category, 12 students (46.15%) are in the medium category, 5 students (19.23%) are in the poor category, and 2 students (7.69%) are in the very poor category. This data shows that almost half of the research subjects were in the medium category, which indicates that mastery of sprinting techniques was not optimal even though the students had taken part in athletic learning.

Students in the very good category show biomechanical characteristics that approach ideal sprint technique, such as optimal hip extension angles in the push off phase, efficient stride length,

and acceleration transition to a stable maximum speed phase. In contrast, students in the poor and very poor categories showed consistent movement inefficiency in almost all running phases.

To clarify the analysis of the sprint running phases, the division of the 100 meter running phases is illustratively shown in Figure 2.
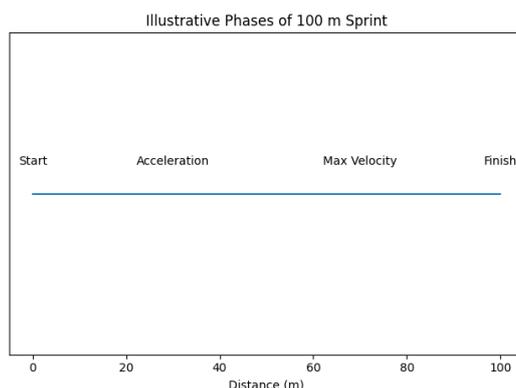

Fig 2. Ilustrative Phases of 100 m Sprint

Figure 2 shows that the acceleration phase plays an important role in determining the quality of maximum speed. The results of Kinovea's analysis revealed that most students in the moderate and low categories experienced acceleration durations that were too long, thereby reducing speed efficiency in the next phase.

In addition, the difference in hip extension angle as an important indicator of sprint efficiency is shown illustratively in Figure 3.
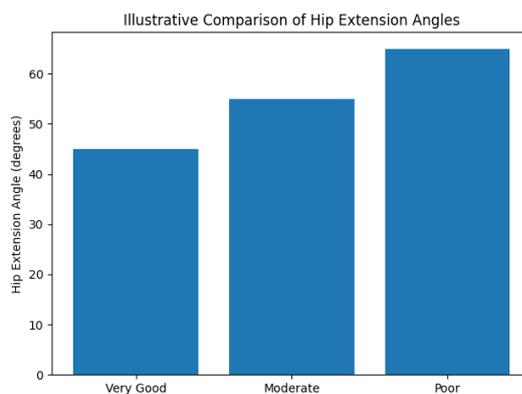

Fig 3. Ilustrative Comparison Of Hip Extension Angle

Figure 3 shows that students in higher skill categories have more optimal hip extension angles, which contribute to more effective horizontal thrust.

The results of this study show that the 100 meter sprint skills of PKO FIK UNIMED students are predominantly in the medium category. These findings indicate that mastery of basic sprint techniques has been established, but the biomechanical efficiency of the movement has not developed optimally. This is in line with the biomechanical theory of sprinting which emphasizes that maximum performance is not only determined by strength and speed, but also by the quality of movement coordination and efficient joint working angles (Pietraszewski et al., 2025).

Students in the very good and good categories show movement patterns that approach ideal sprint biomechanical principles, such as a forward body angle during the acceleration phase, strong hip extension during push off, and stable synchronization of arm and leg movements. This condition supports the theory that mechanical efficiency of movement will increase the transfer of force in the horizontal direction, so that running speed can be maximized.

On the other hand, the dominance of the moderate and poor categories shows that the majority of students still experience technical errors of a biomechanical nature, such as leg thrust angles that are too small, short steps, and inconsistencies in step rhythm. Kinovea analysis allows objective identification of such errors, which are often difficult to detect through conventional visual observation. These findings strengthen Rahadian's (2018) view that small errors in sprint biomechanical parameters can have a significant impact on reduced performance.

From a learning perspective, the use of Kinovea provides significant added value. Video-based visual feedback and numerical data enable students to understand movement errors in a concrete and reflective manner. This approach is in line with the concept of technology-enhanced learning, where technology functions as a facilitator for understanding abstract concepts through visualization and objective data. In this way, Kinovea not only acts as an evaluation tool, but also as a learning medium that encourages active and evidence-based learning.

Pedagogically, the results of this research confirm that the integration of biomechanical analysis in athletic learning has the potential to improve the quality of students' mastery of sprint techniques. The majority of students who are in the medium and low categories have a great opportunity to improve their skills if learning is focused on correcting technique based on the results of Kinovea's analysis, not solely on increasing the volume of physical training.

Thus, these results and discussion provide empirical evidence that learning innovation based on biomechanical analysis using Kinovea software is a relevant and effective approach for improving 100 meter sprint running skills in higher sports education.

4. Conclusions And Recommendations

Based on the results of research and discussion regarding learning innovations with the application of biomechanical analysis using Kinovea software on the 100 meter short distance running skills of PKO FIK UNIMED students, it can be concluded that the application of technology-based biomechanical analysis provides an objective and measurable picture of the quality of students' sprint techniques. Motion analysis carried out frame-by-frame allows the

identification of detailed biomechanical errors that are not easily observed through conventional observation methods.

The results of the quantitative descriptive analysis show that the majority of students are in the medium skill category, which indicates that mastery of basic sprint techniques has been established, but the biomechanical efficiency of the movement is not optimal. This condition is reflected in joint angles that are less than optimal in the push off phase, stride length that is not yet consistent, and the duration of the acceleration phase which is relatively longer compared to the standard 100 meter sprint technique. These findings confirm that students' sprint performance is not only influenced by physical capacity, but also by the quality of coordination and movement efficiency.

The application of Kinovea software in athletic learning has proven to have a positive contribution in improving the quality of sprint technique evaluation. Biomechanical data-based visual feedback helps students understand the relationship between movement technique and performance in a more concrete and scientific way. Thus, this learning innovation based on biomechanical analysis not only functions as an evaluation tool, but also as an effective learning medium in improving understanding and skills in running the 100 meter sprint in a higher education sports environment.

References

[1] Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches (4th ed.). Thousand Oaks, CA: SAGE Publications.

[2] Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2019). How to design and evaluate research in education (10th ed.). New York: McGraw-Hill Education.

[3] Natanael Tumanggor, S., Fauziah Nasution, S., et al. (2025). Analisis Biomekanika Gerak Sprint Menggunakan Aplikasi Kinovea. Pendas: Jurnal Ilmiah Pendidikan Dasar. https://journal.unpas.ac.id/index.php/pendas/article/view/39778

[4] Pietraszewski, P., Maszczyk, A., Zając, A., & Gołaś, A. (2025). Muscle Activity and Biomechanics of Sprinting: A Meta-Analysis Review. Applied Sciences, 15(9), 4959.

[5] Podungge, R., Liputo, N., & Tumaloto, E. H. (2024). Pengaruh Metode Bermain terhadap Kemampuan Teknik Dasar Lari Jarak Pendek. JHSJ: Jambura Health and Sport Journal.

[6] Rahadian, A. (2018). Aplikasi Analisis Biomekanik (Software Kinovea) untuk Mengembangkan Kemampuan Lari Jarak Pendek (100 M) Mahasiswa PJKR. Journal of SPORT, 3(1). https://jurnal.unsil.ac.id/index.php/sport/article/view/752

[7] Sugiyono. (2020). Metode penelitian kuantitatif, kualitatif, dan R&D. Bandung: Alfabeta.

[8] Tumanggor, N., Nasution, S. F., et al. (2025). Analisis biomekanika gerak sprint menggunakan aplikasi Kinovea. Pendas: Jurnal Ilmiah Pendidikan Dasar. https://journal.unpas.ac.id/index.php/pendas/article/view/39778