Tolis Ilmiah: Jurnal Penelitian
Vol. 7, No.1

Tracker Application for Frog Movement Analysis as Practicum Activities About Motion Animal

Indah Kristiani Siringo Ringo[1]* dan Ayu Annisa Akbar[2]

[1]Program Studi Pendidikan Fisika, Fakultas Keguruan dan Ilmu Pendidikan Universitas Khairun

Corresponding author:
indahkristiani@unkhair.ac.id

ABSTRAK

One of the animal movements is to jump, walk, and crawl. Analyzing animal movements and routines is a time-consuming process and tends to be subjective, prone to errors due to the fatigue of the observer. The Tracker application is an open-source application used in video analysis and modelling tools to determine the accuracy of values. This study aims to analyze the differences in the movement of jumping frogs with different masses and lengths with the help of Tracker software which can use can use in independent practicum activities for science subjects with animal movements. The tools and materials needed include an Android cellphone camera, frogs, and the Tracker application. The measurement results are in the form of a graph of the frog's jumping motion. Furthermore, the data recorded in the Tracker is analyzed using Excel. From the research results, it can be said that tools that can be used in practicum and can track and analyze jumping movements are effectively used in analyzing changes in the x and y positions concerning time in daily learning applications so that they can be found around. Environment. learning media in practicum material Movement in living things in SMP Semester 2

Keywords: motion concept; tracking apps; frog jump

INTRODUCTION

Science is the knowledge used in studying everything that exists in nature, including humans. Science means a unit of knowledge related to using the way of thinking of the people around and the investigation of the universe and various facts (Widodo *et al.*, 2020). In practice, it is expected that science learning is used as a means for students to examine themselves and the natural environment and apply it to solve problems they are experiencing (Diamond, 2011).

The content of the nature of science is needed in informal science education. Scientists can study how science works through trial and error and intuition. A reasonable justification for adding the nature of science into a curriculum that aims to shape it faster and better (McComas, 2020).

Practical activities are steps in proving theories that have been found or studied previously (Darmaji *et al.*, 2019). Practical activities can train students' skills by utilizing media from laboratory facilities or outside the laboratory (Suryaningsih, 2017). Practical activities simplify the proof of concepts owned by students because students carry out practical activities directly (Putri *et al.*, 2020). According to the opinion (Ardiansyah & Mu'aminah, 2020) Learning activities using the practicum method independently increase the N-Gain value obtained from the scientific attitude questionnaire when conducting the pretest and post-test. Thus, independent practicum activities close to students lives and everyday lives become one of the choices of methods that can make.

The practicum activities carried out by students have not been maximized. Students still find it difficult to obtain information about science learning phenomena in the surrounding environment(Putri *et al.*, 2020). For example, in the concept of motion, namely, the condition of the motion of objects on a certain trajectory. In these conditions, students still find it difficult to determine how much the initial, final, and the speed at a certain time and the acceleration. Although the tools and materials used are still simple, such as a ruler, ticker timer, and stopwatch. Naturally, learning science, especially the concept of motion, can be done by observing animals in the environment of students, for example, observing animals that almost live in various places because of their ability to adapt to their living environment, namely frogs. Animals with the local name Buduk frog are widely available in areas where residents live(Yudha *et al.*, 2015)

This research focuses on practical activities for learning science about animal movements, especially frogs. Franklin Fearing explains that experiments involving animals attracted the attention of almost all physiologists living in the second half of the 19th century' (Fearing, Reflex Action, 161). Experiments were carried out on birds, fish and dogs (Klein, 2018).

Several factors influence animal movement, such as foraging behaviour, human disturbance and topography, that can be included in the mechanistic model (Preisler *et al.*, 2013). Many studies measure hormonal or behavioural changes in direct response to human disturbances without further investigating possible consequences for demographic level, population size, or species resilience from a biological perspective (Baker *et al.*, 2013; Tablado & Jenni, 2017).

Analyzing the motions and routines of frogs is a time-consuming process and tends to be subjective, prone to errors due to observer fatigue (Rachinas-Lopes *et al.*, 2018). Currently, automated and semi-automated video-based tracking methods to minimize manual analysis errors and biases, such as D-Track (Rachinas-Lopes *et al.*, 2018), Tracker (Rossouw *et al.*, 2011), KidTracker (Pérez-Escudero *et al.*, 2014), GroupTracker (Fukunaga *et al.*, 2015) and so on.

The tracking method allows tracking the movements of different animals such as fish (Mirat *et al.*, 2013; Pérez-Escudero *et al.*, 2014), cats (Ramadhanti* *et al.*, 2021), mice (De Chaumont *et al.*, 2012), and primates (Ballesta *et al.*, 2014) also convert video data into positional trajectories over time. Tracker is an open-source application for video analysis and modelling tools (Kang Wee & Kwang Leong, 2015). Tracker makes it easier for students to investigate the centre of mass, changes in position, velocity, and acceleration concerning time and visualize the concept of motion in real-time(Hockicko, 2011; Yusuf, 2016).

Animal movement research using a tracking application previously used mice studied by (Hadi *et al.*, 2019) to observe the Spatio-temporal behaviour of the female rice field mouse (Rattus argentiventer), including home range, home range, habitat use and daily activities using the Ranges computer program. V and use a tracker app. Then the swimming speed calculation was carried out by adult zebrafish (Danio rerio) using a tracking application (Muzakki, 2020). Then an analysis of the snake's motion was carried out in terms of the snake's trajectory pattern. The resulting 3D simulation was in the form of a walking movement using a tracker application. The purpose of this study was to observe the differences in the jumping motion of frogs with different masses and heights to the time taken by the three frogs.

One medium that can analyze the components of a frog's jumping motion is the Tracker application. The solution to this problem is to develop experimental physics activities through video analysis with tracker modelling. This solution is relevant to 21st-century education because students are trained to apply digital technology to master physics (Hockicko *et al.*, 2015). Tracker is software to analyze the motion of objects via video so that parameters of position changes, velocity parameters, acceleration, kinetic energy, potential energy, and other moving object parameters can be generated ((Nugraha *et al.*, 2017); Brown, 2012). Tracker is video analysis and modelling software developed by Open Source Physics (OSP) with a framework using Java (Kang Wee & Kwang Leong, 2015). One advantage of the Tracker is that it can present real physical phenomena and their representations in quantitative data and graphs (Yusuf, 2016). Trackers have been used effectively for learning and teaching about motion (Wee, 2012; Rodrigues, 2013). In these experiments, students used cell phones to record physical events, transfer the recordings to a computer, analyze the recordings with tracker software and analyze further (Gregorio, 2015). On the other hand, the limitation of this solution is that experimental activities can only carry out on events of motion of objects, but motion events of both objects and living things are often encountered in everyday life (Zwickl *et al.*, 2015).

METHOD

Time and Place

This research was conducted in January 2023 in Juhar Village, Bandar Khalifah District, Serdang Bedagai Regency, North Sumatra Province. The selection of this location was based on several considerations, including the potential of the village that is interesting to study, specific problems faced by the local community, or the existence of social phenomena relevant to the focus of the research. Juhar Village, as part of the administrative area of Serdang Bedagai Regency, has unique demographic, geographic, and socio-economic characteristics, which are an important context in data analysis and interpretation of research results.

Research Materials

The research objects used were three frogs with different masses. This difference in mass allows observation of the influence of mass on the variables studied in the experiment. Variations in word mass allow for a more comprehensive and representative analysis and can reveal patterns or correlations between mass and the observed phenomena.

Research design

The research method used is experimental research. In this case, we will analyze the differences in the movement of jumping frogs with different masses and analyze the video with the help of a tracking application by preparing an animal movement file - an experimental video. The tracking application can track and analyze several markers in two dimensions using images from a camera (cell phone, Android). With the help of high-quality cameras and tracking application programs, students can study certain movements, especially in cats, in detail. The frog becomes a movement performer through its trajectory.

Work Procedures

This research was conducted through several stages, namely: first, recording a video of the movement of frogs jumping around the house using an Android camera. Second, the recorded video was processed using a tracking application. Third, the analysis was carried out with the tracking application, starting by entering the recorded video via the file menu >> import >> video >> select the video to be analyzed >> open. Fourth, after the video is available in the tracking application, the frame arrangement is carried out from start to finish with the track menu >> new >> calibration tool >> calibration stick. Fifth, determining the coordinates of the x and y axes of the frog is done with the track menu >> axis >> visible. Sixth, the mass point of the word to be explained is determined using the track menu >> new >> point mass. Finally, the frog jump analysis is carried out by manually placing the frame point on the movement of the jumping frog.

Data analysis

The data obtained is in the form of vertical movement and horizontal movement in two dimensions (x, y). Using Tracker, the component calculated for a jumping frog is the motion v(t). In this experiment three frogs were used, each with a mass of 0.01 kg and a length of 0.10 m, a mass of 0.02 kg and a length of 0.13 cm) and a weight of 0.07 kg. with a length of 0.15 m) (see Figure 1).

a. Frog -A (0.01 kg; 0.10 m) b. Frog-B (0.02 kg; 0.13 m) c. Frog-C (0.07 kg; 0.15 m)

Figure 1. Frog

Frog-A Frog-B Frog-C

Figure 2. Motion Track Frog Jumping

RESULTS AND DISCUSSION

Usage Video analysis of frog jumps with the help of the Tracker application helps students investigate how objects (centre of mass) change position, velocity, and acceleration in time (Hockicko, 2011) and determine the type of motion. Before analyzing the video, the students recorded the movement of the frog jumping first. After that, students can open digital video files to import into Tracker. Students can calibrate scales. Then, determine the appropriate coordinate axes.

The results obtained after the video of the frog jumping were analyzed with Tracker on the position changes each time for each frog as presented in Table 1.

Table 1. The Jump Path of the frog

t (s)	**Frog-A**		**Frog-B**		**Frog-C**	
	x (m)	**y (m)**	**x (m)**	**y (m)**	**x (m)**	**y (m)**
0.00	-0.29	0.33	-0.02	0.08	-0.02	0.06
0.03	-0.6	0, 48	-0.14	0.18	-0.11	0.09
0.07	-1.11	0.70	-0.51	0.36	-0.25	0.16
0.10	-1.71	0.69	- 0.98	0.40	-0.51	0.23
0.13	-2.3	0.36	-1.47	0.24	-0.81	0.22
0.17	-2.9	-0.27	-1 ,97	-0.09	-1,1	0.06

A graph of the relationship between time and position on the x-axis and y-axis can be made.

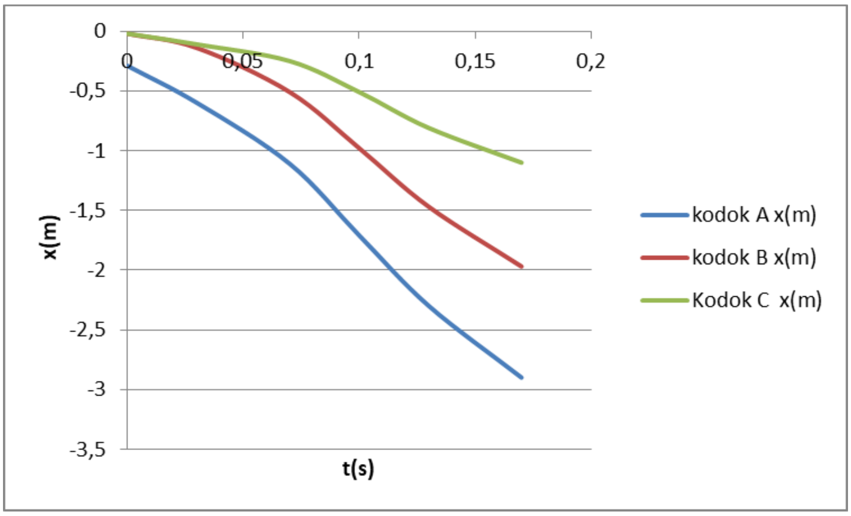

Figure 1. Graph of the Relationship between Time and Position on the x-axis of Frog A, Frog-B and Frog-C.

The graph in Figure 1 shows that the longer the time, the smaller the x position. This means that the position (x) and time have a common value, so the velocity value changes regularly. The experiments carried out can predict that the speed at the reference point is always constant or stable, as shown by a linearity graph. The tracker process will be accurate when the motion of the object being observed is constant and the direction of the moving object remains straight; this is in line with (Setyawan *et al.*, 2017) research, which reveals that the motion of moving objects must be constant; this is intended so that the resulting data has a high level of accuracy and accuracy. Then reinforced by research by Halliday, Resnick, & Walker (2010), which states that motion has a general nature, namely in the form of an assumption where moving objects can be particles and each part moves in the same direction and speed along a straight line either vertically, horizontally, or obliquely. . This is confirmed again by research by (Nugraha *et al.*, 2017) also revealed that the use of the tracker application on the Atwood aircraft shows the characteristics of uniformly straight motion (GLB) and uniformly changing motion (GLBB) so that it is appropriate to use it as a medium in science learning in schools. Then, the analysis of moving objects using tracker applications on motion materials is good to use. The motion of the jumping frog is GLBB. It can be seen from the graph and Tracker above that the data shows the motion of an object on a straight trajectory with an acceleration that increases regularly, or it can be said that the motion of a jumping frog experiences constant acceleration. Same with (Prihatini *et al.*, 2017), which reveal that GLBB is the motion of particles on a straight-line trajectory with a fixed direction of motion that travels a distance that changes regularly every one unit of time, or it can say that its velocity value changes regularly and has a constant acceleration value.

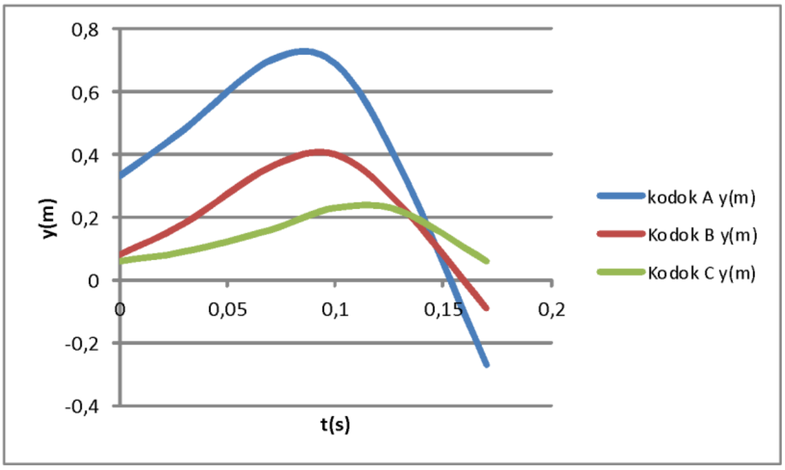

Figure 2. Graph of the Relationship between Time and Position on the y-axis of Frog A, Frog-B and Frog-C.

The graph of changes in position (y) on Frog-A, Frog-B and Frog-C Observations show that at a certain time, when each frog reaches its maximum height, the frog will fall due to the force of gravity. Frog A had the highest jumping height of 0.7m in 0.07s. Frog A had the highest jumping highest jumping height of 0.23m in 0, 21s.

CONCLUSION

The experimental results showed that the graph of the relationship between frog-A, Frog-B and Frog C when jumping had a constant or stable speed indicated by a linearity graph. Then the graph of each reference point is dominated by the high speed of Frog A compared to Frog-B and Frog-C. In addition, data processing using the tracker application is more accurate and consistent, so it can conclude that using video analysis of frog jumps with the help of applications is appropriate for use in physics learning as practicum material to help students interpret. The resulting data is in graphs and data tables to draw conclusions and make it easier for students to identify the magnitudes of motion properly and correctly.

REFERENCES

Ardiansyah, & Mu'aminah. (2020). Analisis Sikap Ilmiah Peserta Didik Pada Praktikum Mandiri Berbasis Proyek Pada Materi Optik Smpn 4 Sojol di Masa Pandemik. *Jurnal Pembelajaran Matematika Dan Sains*, *1*(2), 31–38.

Baker, M. R., Gobush, K. S., & Vynne, C. H. (2013). Review of factors influencing stress hormones in fish and wildlife. *Journal for Nature Conservation*, *21*(5), 309–318. https://doi.org/10.1016/j.jnc.2013.03.003

Ballesta, S., Reymond, G., Pozzobon, M., & Duhamel, J. R. (2014). A real-time 3D video tracking system for monitoring primate groups. *Journal of Neuroscience Methods*, *234*, 147–152. https://doi.org/10.1016/j.jneumeth.2014.05.022

Darmaji, D., Kurniawan, D. A., Astalini, A., & Samosir, S. C. (2019). Persepsi Mahasiswa Pendidikan Biologi Dan Pendidikan Kimia Terhadap Penggunaan Buku Panduan Praktikum Fisika Dasar Berbasis Mobile Learning. *Edusains*, *11*(2), 213–220. https://doi.org/10.15408/es.v11i2.11185

De Chaumont, Coura, R. D. S., Serreau, P., Cressant, A., Chabout, J., Granon, S., & Olivo-Marin, J. C. (2012). Computerized video analysis of social interactions in mice. *Nature Methods*, *9*(4), 410–417. https://doi.org/10.1038/nmeth.1924

Fukunaga, T., Kubota, S., Oda, S., & Iwasaki, W. (2015). GroupTracker: Video tracking system for multiple animals under severe occlusion. *Computational Biology and Chemistry*, *57*, 39–45. https://doi.org/10.1016/j.compbiolchem.2015.02.006

Gregorio, J. B. (2015). Using Video Analysis , Microcomputer-Based Laboratories (MBL ' s) and Educational Simulations as Pedagogical Tools in Revolutionizing Inquiry Science Teaching and Learning. *K-12 STEM Education*, *1*(1), 43–64.

Hadi, S., Subagja, J., & Sudarmaji, S. (2019). Perilaku Spasio Temporal Tikus Sawah (Rattus argentiventer) Betina. *Biota: Jurnal Ilmiah Ilmu-Ilmu Hayati*, *XI*(2), 110–115. https://doi.org/10.24002/biota.v11i2.2630

Halliday, D., Resnick, R., & Walker, J. 2010. Fisika dasar 1 Edisi 7 Jilid 1, Erlangga, Jakarta

Hockicko, P. (2011). Forming of physical knowledge in engineering education with the aim to make physics more attractive. *Physics Teaching in Engineering Education (PTEE)*, 1–5.

Hockicko, P., Krišťák, L., & Němec, M. (2015). Development of students' conceptual thinking by means of video analysis and interactive simulations at technical universities. *European Journal of Engineering Education*, *40*(2), 145–166. https://doi.org/10.1080/03043797.2014.941337

Kang Wee, L., & Kwang Leong, T. (2015). Video Analysis and Modeling Performance Task to Promote Becoming Like Scientists in Classrooms. *American Journal of Educational Research*, *3*(2), 197–207. https://doi.org/10.12691/education-3-2-13

Klein, A. (2018). The curious case of the decapitated frog: on experiment and philosophy. *British Journal for the History of Philosophy*, *26*(5), 890–917. https://doi.org/10.1080/09608788.2017.1378866

Mirat, O., Sternberg, J. R., Severi, K. E., Wyart, C., & Perez-escudero, A. (2013). *ZebraZoom: an automated program for high-throughput behavioral analysis and categorization*. *7*(June),

1–12. https://doi.org/10.3389/fncir.2013.00107
Muzakki, A. (2020). Tugas Akhir Tugas Akhir. *Jurnal Ekonomi Volume 18, Nomor 1 Maret201*, *2*(1), 41–49.
Nugraha, F., Wulansari, R., Danika, I., Nurafiah, V., Lathifah, A. N., Sholihat, F. N., Susanti, H., Nugraha, M. G., & Kirana, K. H. (2017). *Eksperimen Pesawat Atwood Berbasis Pengolahan Aplikasi Tracker Untuk Mengamati Fenomena Gerak Lurus Beraturan Dan Gerak Lurus Berubah Beraturan Pada Pembelajaran Fisika Sma*. *VI*,SNF2017-EER-15-SNF2017-EER-20. https://doi.org/10.21009/03.snf2017.01.eer.03
Pérez-Escudero, A., Vicente-Page, J., Hinz, R. C., Arganda, S., & De Polavieja, G. G. (2014). IdTracker: Tracking individuals in a group by automatic identification of unmarked animals. *Nature Methods*, *11*(7), 743–748. https://doi.org/10.1038/nmeth.2994
Preisler, H. K., Ager, A. A., & Wisdom, M. J. (2013). Analyzing animal movement patterns using potential functions. *Ecosphere*, *4*(3), 1–13. https://doi.org/10.1890/ES12-00286.1
Prihatini, S., Handayani, W., & Agustina, R. D. (2017). Identifikasi Faktor Perpindahan Terhadap Waktu Yang Berpengaruh Pada Kinemetika Gerak Lurus Beraturan (Glb) Dan Gerak Lurus Berubah Beraturan (Glbb). *Journal of Teaching and Learning Physics*, *2*(2), 13–20. https://doi.org/10.15575/jotalp.v2i2.6580
Putri, A. H., Liliawati, W., Purwana, U., Sari, I. M., Iryanti, M., Putra, S. M. P., Lembang, S., & Barat, K. B. (2020). Analisis Gerak Lurus Dalam Fluida dengan Menggunakan Aplikasi Tracker. *Prosiding Seminar Nasional Fisika 6.0*, *0*, 281–285.
Rachinas-Lopes, P., Ribeiro, R., Dos Santos, M. E., & Costa, R. M. (2018). D-Track—A semi-automatic 3D video-tracking technique to analyse movements and routines of aquatic animals with application to captive dolphins. *PLoS ONE*, *13*(8), 1–12. https://doi.org/10.1371/journal.pone.0201614
Ramadhanti*, D., Kuswanto, H., Hestiana, H., & Azalia, A. (2021). Penggunaan Analisis Video Gerak Kucing Melompat Berbantuan Aplikasi Tracker Sebagai Kegiatan Praktikum Mandiri Materi Gerak pada Peserta Didik SMP. *Jurnal Pendidikan Sains Indonesia*, *9*(3), 459–470. https://doi.org/10.24815/jpsi.v9i3.20547
Rossouw, A., Hacker, M., & De Vries, M. J. (2011). Concepts and contexts in engineering and technology education: An international and interdisciplinary delphi study. *International Journal of Technology and Design Education*, *21*(4), 409–424. https://doi.org/10.1007/s10798-010-9129-1
Setyawan, D. N., Sarwanto, S., & Aminah, N. S. (2017). Pengembangan Pembelajaran Berbasis Saintifik pada Materi Dinamika Rotasi dan Kesetimbangan Benda Tegar untuk Meningkatkan Kemampuan Berpikir Kritis dan Komunikasi Verbal Siswa SMA. *Jurnal Penelitian Pembelajaran Fisika*, *8*(1), 14–25. https://doi.org/10.26877/jp2f.v8i1.1332
Suryaningsih, Y. (2017). *PEMBELAJARAN BERBASIS PRAKTIKUM SEBAGAI SARANA SISWA UNTUK BERLATIH MENERAPKAN KETERAMPILAN PROSES SAINS DALAM MATERI BIOLOGI*. *2*(2), 49–57.
Tablado, Z., & Jenni, L. (2017). Determinants of uncertainty in wildlife responses to human disturbance. *Biological Reviews*, *92*(1), 216–233. https://doi.org/10.1111/brv.12224
Widodo, W., Sari, D. A. P., Suyanto, T., Martini, M., & Inzanah, I. (2020). Pengembangan keterampilan pemodelan matematis bagi calon guru IPA. *Jurnal Inovasi Pendidikan IPA*, *6*(2), 146–155. https://doi.org/10.21831/jipi.v6i2.27042
Yudha, D. S., E, R., A, M. F., & T, A. (2015). Keanekaragaman Jenis Katak Dan Kodok (Ordo Anura) Di Sepanjang Sungai Opak Propinsi Daerah Istimewa Yogyakarta. *Jurnal Biologi*, *18*(2), 52–59.
Yusuf, E. (2016). *SCIENCE & TECHNOLOGY Using Tracker to Engage Students ' Learning and Research in Physics*. *24*(April), 483–491.
Zwickl, B. M., Hu, D., Finkelstein, N., & Lewandowski, H. J. (2015). Model-based reasoning in the physics laboratory: Framework and initial results. *Physical Review Special Topics - Physics Education Research*, *11*(2), 1–12. https://doi.org/10.1103/PhysRevSTPER.11.020113