Education in Physics Revista Mexicana de Física E **22** 020203 1–13 JULY–DECEMBER 2025

An analysis of the motion of Hombo Batu jumping in nias using trackers, GNU octave and spreadsheets

A. Wijayanti[a,e], H. Kuswanto[b], A. Datiatur Rahmat[a], A. Samsudin[d], A. Yoga Purnama[e], J. Jumadi[b], and A. Wiyarsi[f]

[a]*Department of Science Education, Faculty of Mathematics and Science, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia, e-mail: astutiwijayanti.2021@student.uny.ac.id*

[b]*Department of Physics Education, Faculty of Mathematics and Science, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia.*

[d]*Department of Physics Education, Faculty of Mathematics and Science, Universitas Pendidikan Indonesia, Bandung, Indonesia.*

[e]*Department of Science Education, Faculty of Training Teacher and Education, Universitas Sarjanawiyata Tamansiswa, Yogyakarta 55167, Indonesia.*

[f]*Department of Chemistry Education, Faculty of Mathematics and Science, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia.*

Received 13 December 2022; accepted 19 April 2024

Culture is one of the teaching materials in education. But in reality, it is still rare to use culture in teaching because education and culture look like two different things. Culture and education are considered separate things, even though the former is important to be integrated into the latter so that it is sustainable. Students can learn Indonesian culture through cultural integration in education that follows the trend of digitization so that they learn science meaningfully according to the demands of the times. This research aims to use tracker software, GNU Octave and Spreadsheet to visualize the parabolic motion of Hombo Batu jumpers and as an alternative learning tool. Euler Cromer's method was used in the GNU Octave Software and compared the results with Software Tracker. Hombo Batu jumper movements were recorded, and then analysed using tracker software. Data processing was done through a manual process using the parabolic motion formula and the law of conservation of mechanical energy. This tracker software can analyse the video on each tracker. This research used the experimental method. The experiment incorporates a video from YouTube, a tracker, and spreadsheets. The data collection was through tracker experiments, literature studies, and documentation. The data analysis used descriptive techniques. This paper succeeds in making parabolic motion visualization of Hombo Batu jumpers in Nias in ethnoscience-based learning to develop students' thinking skills analytically and numerically. Software Tracker and Spreadsheet are easier to use because they don't use a complicated programming language like GNU Octave. The experimental results show that through a tracker the value of the acceleration of gravity in the Hombo Batu jump is 9.38 m/s^2. This shows that the Hombo Batu jumping movement in Nias can be integrated through an ethno-scientific approach so that students can learn science from Indonesian culture. Trackers and spreadsheets can help students think analytically, so they should be used in other learning materials as well. Trackers and spreadsheets can be used as an alternative to learning parabolic motion.

Keywords: Motion; hombo batu; tracker; GNU octave; spreadsheet.

DOI: https://doi.org/10.31349/RevMexFisE.22.020203

1. Introduction

Education plays an important role in developing culture [1]. When students learn science, they should not only be able to think logically and creatively, but also be cultured and able to continue the nation's great history [2]. Cultural perceptions are still very attached to lessons in music, dance, painting, and others, not integrated with other learning. The integration of culture into learning materials in the classroom is still very rare at various levels of education [3]. In addition to the material being less contextual, students have difficulty understanding concepts and make cultural values begin to fade.

Indonesia is a country rich in various cultures. One of the cultures that can be internalized in learning is Hombo Batu. Hombo Batu jumping is very interesting because it is a rock-jumping tradition on Nias Island, North Sumatra which was born due to tribal conflicts in the region [4]. This tradition uses stones, approximately 2 meters high with a bottom surface of about 120 centimetres wide, which are jumped. This jumping stone is a natural rock taken directly from nature, which is scraped and shaped as needed to form a pyramid-like building. In addition to the pyramid-shaped jumping stone, in this tradition, there is also a stone of a smaller size as a pedestal, which is located near the stone. Rock jumping is only done by men. Stone jumping developed in the Nias Islands, North Sumatra was a means of training soldiers to prepare for war in ancient times. The stone jumper's trajectory is in the form of a parabolic arch, so this culture can be integrated into science learning with the subject matter of parabolic motion.

In this tradition, there are several superior characteristics, including being able to train: (1) physical strength and agility, (2) courage and fighting power, (3) forging maturity and readiness to face life's challenges, (4) tenacity and enthusiasm for practice, and (5) heroism and nationalism [4]. However, this tradition is starting to fade, and it is increasingly rare for people to be able to jump rock Hombo. Therefore, it is necessary to innovate by integrating cultural products into technology. People can develop traditional art to become part of modern life by trying to modify art forms that are still patterned in the past to be used as commodities that can be consumed by modern society [5]. One of them is through education.

One of the materials in lectures in science education is the parabolic motion of two-dimensional kinematics. Parabolic motion is the movement of particles with a certain initial speed and elevation angle due to the influence of gravity, where the particle trajectory is in the form of a parabolic [6]. Components of motion of objects in the x-axis direction (horizontal direction) experience Uniform Straight Motion (USM) while the components of motion of objects on the y-axis (vertical direction) experience Uniformly Changed Straight Motion (UCSM) events. The speed in the USM is constant, while in the UCSM the speed will change because it is influenced by the force of gravity [7].

Although this material is often encountered in everyday life, students experience the following difficulties: 1) describing the x and y component vectors; 2) distinguishing the velocity vector, velocity component vector, and velocity vector component in the x and y directions; 3) focusing on memorizing the formula for the time taken by the bullet for a half parabolic trajectory, maximum height, and maximum farthest distance; 4) having the assumption that the final velocity of a parabolic moving object when it hits the ground is always zero; 5) understanding the velocity of the object is zero at the top (whereas only the velocity in the vertical direction is zero); 6) understanding the acceleration of objects in the x and y directions, and 7) using the sine cosine rule of triangles in determining distance/height and vice versa (even though the determination of distance/height is based on speed information) [8,9]. In addition, this material is rarely integrated into other disciplines and cultures of the community.

These difficulties can occur due to learning only by observing the material in the learning video and not being able to develop students' thinking and analysis in finding information related to the material [10,11] and because there are no teaching aids that can be used to simulate applied material [12-14]. Laboratory practice must be carried out to prove or obtain concepts [15,16]. However, during this pandemic, laboratory activities have been suspended. This makes it more difficult for students to build scientific concepts from the studied material. Whereas the seven indicators of conceptual understanding in the classroom that use teaching aids as learning media obtained five indicators that have increased in the high category, namely the indicators of interpreting, exemplifying, classifying, guessing, and explaining [7,8,17,18]. This shows that in learning educators should be able to use learning media as a tool to make it easier for students to build an understanding of concepts.

The ability to interpret data from tables and graphs and apply functions to solve problems are important areas for testing numeracy literacy [19]. Data reasoning is an important component of scientific reasoning [20]. Knowledge will guide the interpretation of data, but data also guide the evaluation and creation of knowledge [21]. In the acquisition of knowledge, knowledge can precede data or data can precede knowledge. Students begin to pay attention to data only when they detect inconsistencies with their existing knowledge. But in reality, in general, they still have difficulty using certain measuring instruments, coordinating quantitative data with the measured phenomenon, and correctly interpreting the significance of variations, uncertainties, and errors in the data [22]. They will try in various ways to overcome the difficulties experienced. Teachers should facilitate them to see the relationship between variables in the experiment, but first, teachers need to identify exactly how students engage with the concept of data analysis. One of the teachers' efforts to help students with difficulties in developing these skills is by using a tracker, GNU Octave and spreadsheet applications.

Most science subjects are currently taught outside the laboratory for experimental activities, using computer-based software simulation packages [23]. The tracker can be done by students easily because it can be accessed anywhere and anytime. The simulation analysis results can be applied again in an Excel spreadsheet for further use in data analysis. Spreadsheets can easily and effectively process and display data in the form of numbers and graphic images [24]. Trackers and spreadsheets have been widely used in experiments, but experimental activities using tracker software and spreadsheets rarely analyze the Hombo Batu tradition. This research aims to use tracker software, GNU Octave and Spreadsheet to visualize the parabolic motion of Hombo Batu jumpers and as an alternative learning tool.

2. Method

2.1. Research design

The methodology is the qualitative description with an ethnographic approach [25-27]. This approach was chosen with consideration to better understand the analysis of Hombo Batu tradition in Nias. In addition, the knowledge of Hombo Batu is explored about how to analyze the mechanism of the parabolic motion. The object of this research is the mechanism of Hombo Batu jumping on a Tora hoso using video with the help of a tracker and spreadsheet application analysis. A Hombo Batu jumper in Nias becomes the focus of the motion that passes through the trajectory. The movement of the Hombo Batu jumper is recorded and entered into the tracker application. The data collection uses the synthesis and experimental analysis of Hombo Batu jumper motion on the tracker and spreadsheet. This simulation is used to visualize the movement parameters resulting from the Hombo Batu jumper. Furthermore, the data were processed and analysed descriptively.

2.2. Sample

To get information according to the purpose of the study, the informant selection technique uses purposive sampling. The video of the Hombo Batu jumper in Nias is used from the YouTube channel. The number of videos used in one video. The YouTube video used is at the link: `https://www.youtube.com/watch?v=ScRVMXxWNZo` with the criteria of using the tara hoso stone in Nias, using the left foot, and the movement of the Hombo Batu jumper being captured by the camera clearly, which is taken from a position perpendicular to the tara hoso stone maybe a picture can be added.

The video is downloaded from YouTube at 480 p resolution. The nature of the obtained video does not allow us to measure all variations in the angle of the body part because it requires the camera to be in a fixed place and at a right angle to the object under study. Thus, we performed angle measurements only on the body concerning the ground level and took frame rate/duration measurements [28]. Therefore, we only use very useful videos to get some useful information and interpret the meaning of the content.

2.3. Instrument

The data analysis technique used includes four main processes, namely: (1) data collection through literature and documentation, (2) data reduction, (3) data presentation in the form of narrative text, and (4) conclusion [29]. The data collection was through tracker experiments, literature studies, and documentation. This research used a YouTube video about the Batu jump in Nias that fits the criteria, a tracker application, and a spreadsheet. The movement of the Hombo Batu jumper in the video was then analyzed using a tracker application. Through data tables and graphs, we could analyze them according to the required variables. Literature studies were used to study the customs of Hombo Batu and mathematical analysis of the motion of the Hombo Batu jumper. Documentation was used to collect, process, store, retrieve and distribute documents related to the Hombo Batu tracker analysis.

2.4. Data analysis

The data analysis used descriptive techniques. Descriptive data were collected in the form of a table and video. This work had several drawbacks. First, the video was taken from YouTube, so it did not allow us to set the exact angle position from the right angle. Second, the video results seemed to move in several places, causing some difficulties during the analysis. The video analysis was a movement evaluation method that could be very useful in sports movements, such as in the Hombo Batu tradition. Using video analysis software, the operator could visualize and process the desired parameters and objectify and carry out scientific and reliable studies of calculated movements or specific sequences of actions [30]. The subjects under analysis were completely free from any restrictions.

In addition to solving analytically, we have other alternatives, namely numerical solutions. The Euler-Cromer method is used in this article.

$$y_{\text{next}} = y_{\text{current}} + a_n \Delta x.$$

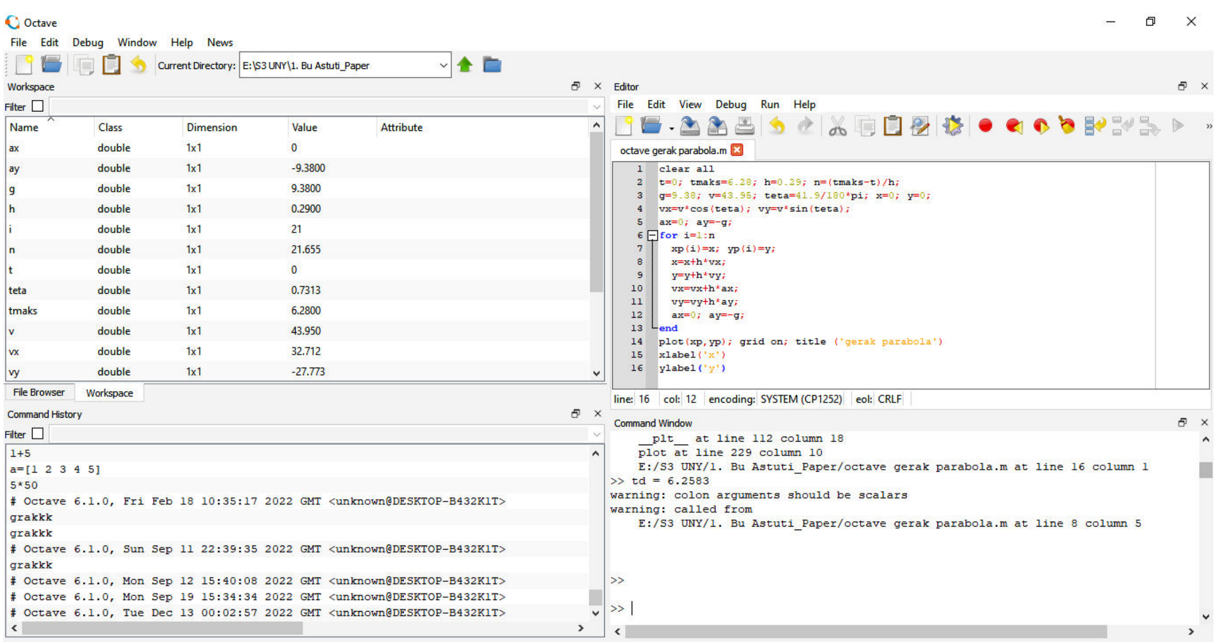

FIGURE 1. GNU Octave coding for parabolic motion.

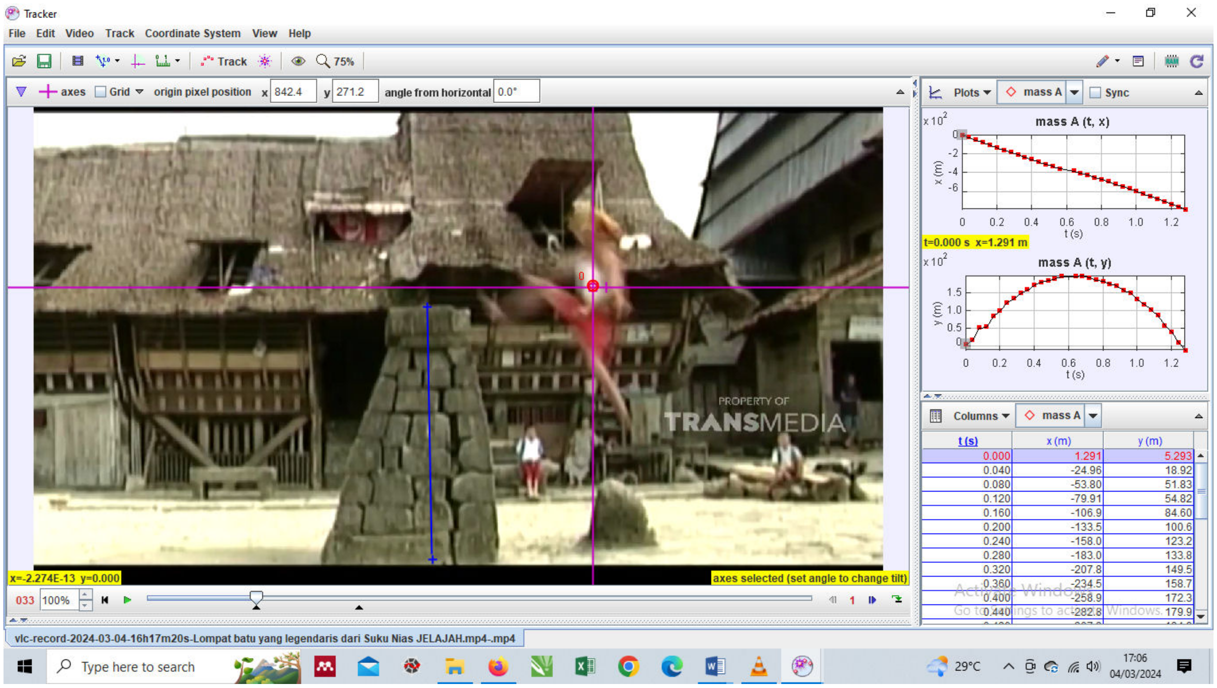

FIGURE 2. Auto tracker process.

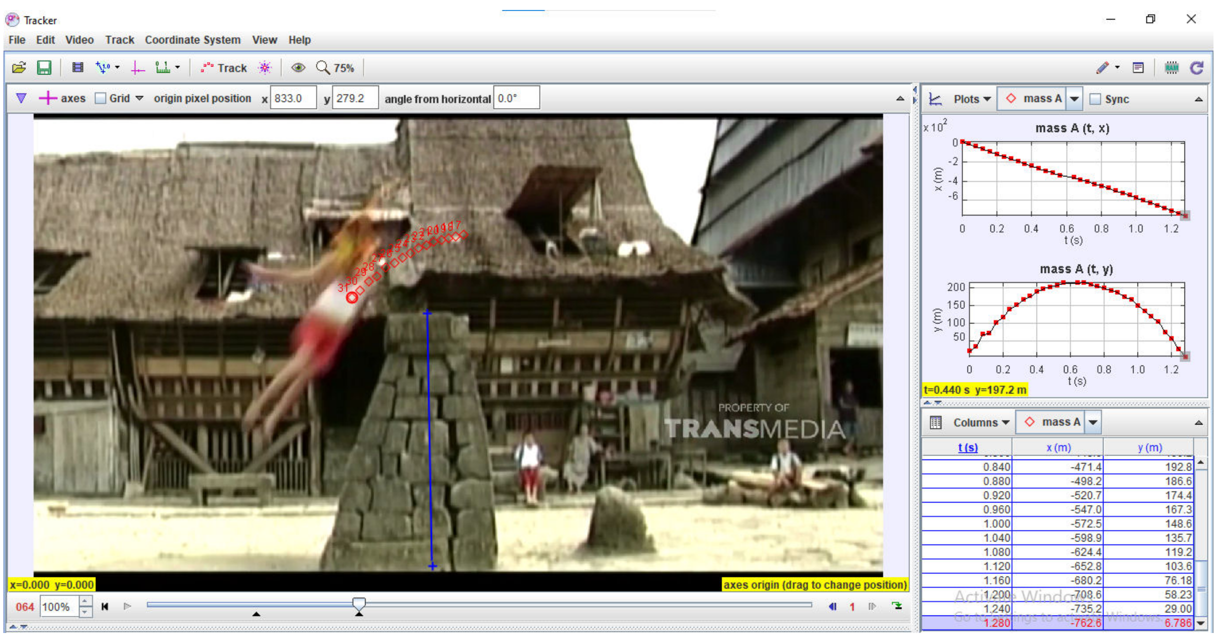

FIGURE 3. Results of tracker analysis.

The coding display used in the GNU Octave programming is shown in Fig. 1.

3. Results and discussion

3.1. Analysing Hombo Batu jumping

Hombo Batu jumping is identified as an example of the application of parabolic motion, so it is necessary to first trace it kinematically. The data retrieval results with a tracker experiment from a selected Hombo Batu YouTube video were analyzed using a tracker application shown in Figs. 2 and 3. The motion analysis procedure with the video tracker is as follows: 1) record video using a cellphone camera or the like for moving objects to be analysed with the video tracker application; 2) upload/import videos in the tracker; 3) set frames; 4) calibrate the stick; 5) set the x-axis and y-axis; 6) determine the point mass of the object to be analyzed, and 7) analyse

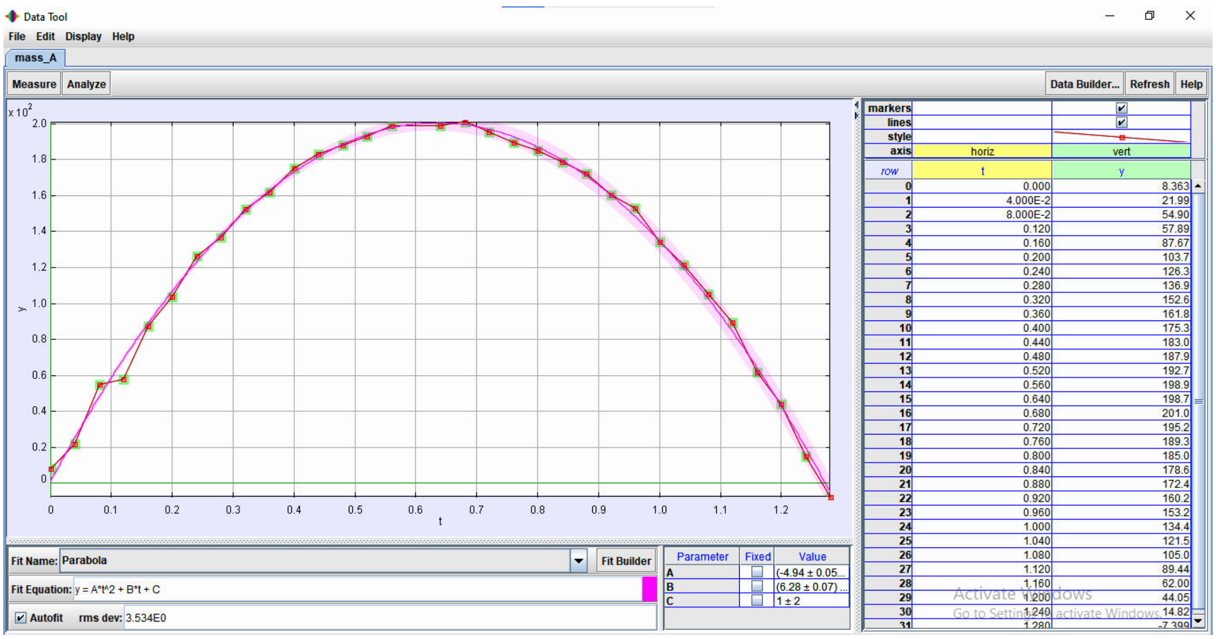

FIGURE 4. Stone Hombo jumper parabolic trajectory chart (y versus t).

the motion of objects with the auto-track command. From the Fig. 2, it can be interpreted that the jumper moves from the initial position when he steps on the tara hoso repulsion stone towards the ground having a parabolic motion. Figure 2 was selected with the center of mass on the jumper's torso or abdomen. This happens because the jumper makes a certain angle with the horizontal axis when leaving the repulsion stone. The next concept that can be learned from the output is that the motion of a parabola is two-dimensional, a superposition of two motions. In the x-direction, the jumper's acceleration is zero, while in the y-direction the acceleration is constant with the gravitation value. The magnitude of the acceleration is due to gravity.

Data analysis can be shown in section analyze and in the fit name select parabola, so we get the graph equation parabola, which contains information for determining the value of the acceleration due to gravity. Tracker data analysis can be shown in Fig. 4. First, observe the motion on the x and y axes.

Figure 4 shows the Hombo Batu jumper is moving along a parabolic path. As for the parabolic equation obtained in the Tracker software, namely:

$$y = -4.69t^2 + 6.28t - 1.5.$$

Through the parabolic equations of motion, the tracker software shows that the value of the acceleration due to gravity is obtained from parameter a, which is -1/2 g. So that the value of the acceleration due to gravity is 9.88 m/s^2.

The graph $y = f(t)$ can describe the motion in the vertical direction with the acceleration of gravity. From the graph, we have an equation:

$$\begin{aligned} y &= -4.94t^2 + 6.28t - 1.5, \\ y &= v_{o_y} t - 1/2gt^2, \\ -1/2gt^2 &= -4.94t^2, \\ 1/2g &= 4.94, \\ g &= 9.88 \ \text{ m/s}^2. \end{aligned}$$

Then, the analysis of the function of the position of x against time t is in Fig. 5.

The graph $x = f(t)$ can describe motion in the horizontal direction without the acceleration of gravity that is downwards

$$\begin{aligned} y &= -4.94t^2 + 6.28t - 1.5, \\ x &= -5.89t - 9, \\ y &= v_{o_y} = 6.28 \ \text{ m/s}, \\ x &= v_{o_x} = 5.89 \ \text{ m/s}. \end{aligned}$$

So, we already know the formula for calculating velocity on the x-axis (V_x) and velocity on the y-axis (V_y). Then, we can find the value of the velocity (V), using the following velocity resultant formula:

$$\begin{aligned} v &= \sqrt{{v_x}^2 + {v_y}^2}, \\ v &= \sqrt{5.89^2 + 6.28^2}, \\ v &= \sqrt{7.12}, \\ v &= 8.6 \ \text{ m/s}. \end{aligned}$$

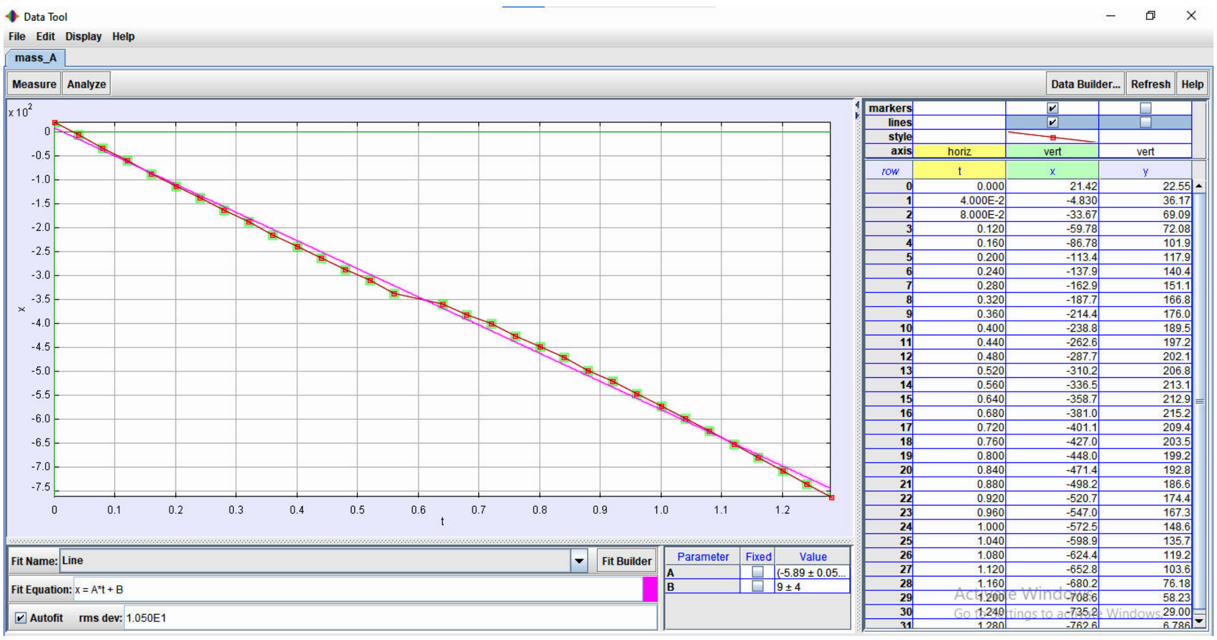

FIGURE 5. Stone Hombo jumper linear trajectory graph (x versus t).

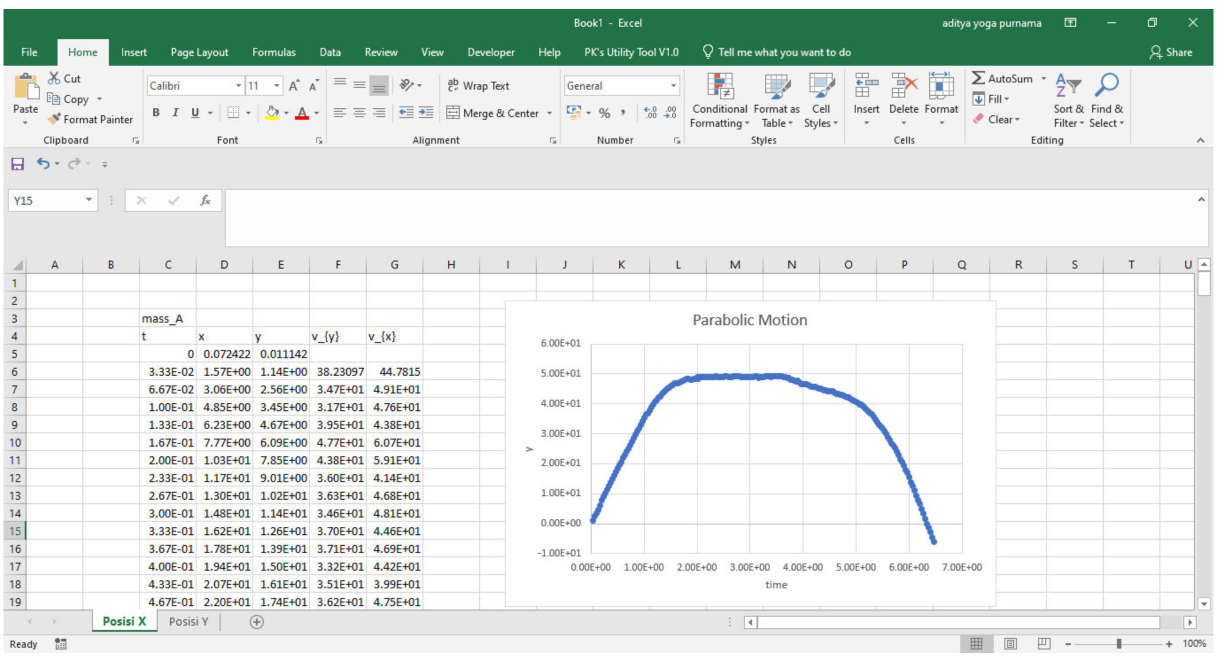

FIGURE 6. Parabolic motion using a spreadsheet.

So, from the V_y and V_x values, we can also calculate the elevation angle, we can use the angle formula:

$$\tan\alpha = \frac{v_y}{v_x},$$

$$\alpha = \arctan\left(\frac{v_y}{v_x}\right),$$

$$\alpha = 46.7^\circ.$$

Next, we calculate the time needed by the jumper to get the furthest point with the following formula:

$$v_y = 6.28 \text{ m/s},$$

$$v_y = v_o \sin(a) - gt,$$

$$t = 1.23 \text{ s}.$$

Then, we calculate the maximum height with the following formula:

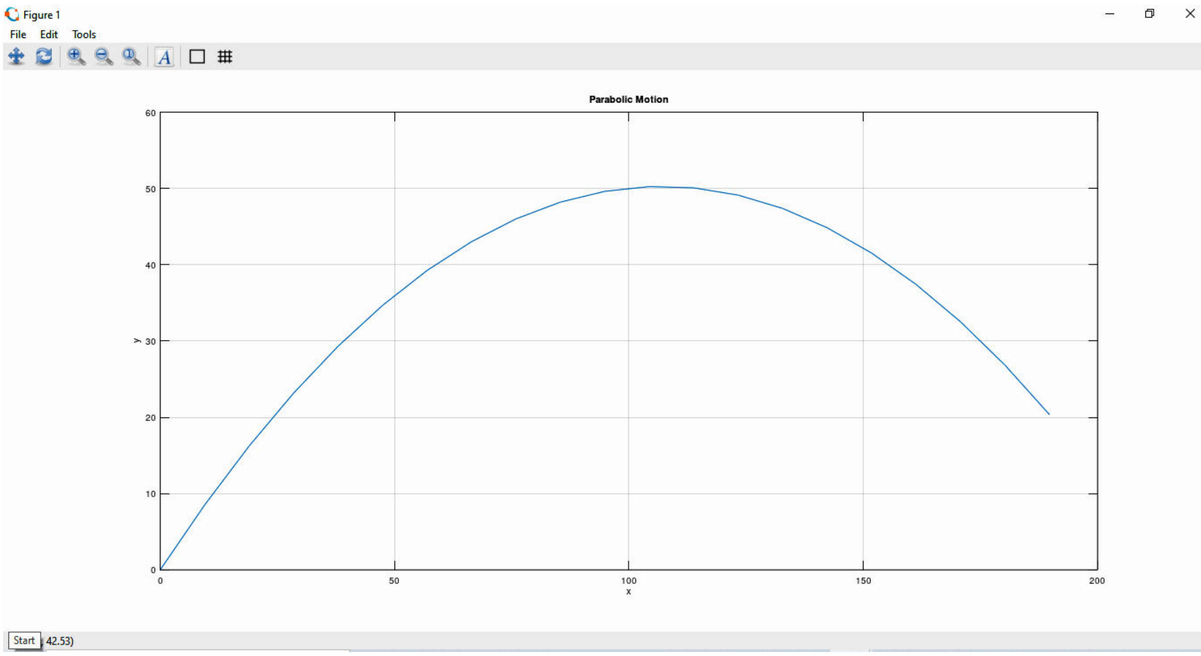

FIGURE 7. Simulation from GNU octave.

$$y = 6.28(1.23) - 1/2(9.88)(1.23)^2,$$
$$y = 0.25\, m = h_{\max}.$$

Figure 6 shows the data from the tracker analysis plotted onto a spreadsheet. Students can understand graphs starting from how to make plots to the variables studied. Spreadsheets are used as visual aids to make it easier for students to understand the material. This shows that Spreadsheet can easily and effectively process and display data in the form of numbers and graphic images as described in Ref. [31].

The calculation above is an analytical solution, we have another alternative to solve the problem, namely with a numerical solution. In this article, we use the Euler-Cromer method. From Fig. 7, it can be interpreted that this article has succeeded in making numerical and analytical simulations. Meanwhile, the detailed explanation or information in Fig. 7 is as follows; The GNU Octave software is a duplication of the Matlab software. The script starts by writing coding to the m-file section, first inputting data including: time to reach the top, altitude, gravity, initial velocity, angle and initial position of the object. Next, we use the equation to find the velocity on the x-axis and the velocity on the y-axis. Next, create data iterations using the Euler Cromer method. Nex,t we plot the x and y components.

3.2. Analysis of the Hombo Batu for science concept

Based on the results of the analysis of the motion of the Hombo Batu jumper, then the results are reviewed with a literature review, which can be described as follows: The Hombo Batu jump on a tara hoso is similar to the high jump in athletics. The high jump consists of three stages, namely: 1) in the first stage, the athlete runs along a linear track; 2) in the second stage, the athlete runs along a curve instead of running along a straight line, and 3) in the third stage, the high jump is the actual jump [32].

The Hombo Batu jumping tradition in Nias is one of the traditions of a Hombo Batu jumper who starts the jump on a steppingstone in the Nias language called *tara hoso*.

In the implementation of the stone jump with a height of 2 m, the jumper must run fast from a distance of 18 m or a distance most appropriate to him. Just before jumping, the jumper must step on the stepping stone/repulsion or in Nias language called tara hoso, to throw his body up beyond the jumping stone without coming into contact with the top of the jumping stone. Then he lands behind the jumping stone. The stepping stone has a base size of 30 cm (IJ) $\times$ 30 cm (HI), the height of the stepping stone is 50 cm (near the Hombo Batu side) and 35 cm (facing the starting line), and the distance between the backside of the stepping stone and the front side of the stepping stone is 90 cm (GH). The area of the base of the jumping stone is 90 cm (EF) $\times$ 60 cm (DE) which is getting smaller on the top of the stone so that the area of the rock peak is 80 cm (AB) $\times$ 40 cm (BC). These sizes are described as follows in Fig. 8.

In this tradition, there is the application of parabolic motion.

A Hombo Batu jumper will run very fast when making a start to have great strength before repelling the steppingstone and he requires the right slope. The greater the initial speed the jumper makes, the greater the repulsion force of the jumper will be, so this will move his body towards the top of the rock and land on the ground in good condition. The trajectory of the Hombo Batu jumper when in the air forms

FIGURE 8. Hombo Batu Scheme

FIGURE 9. Hombo Batu jumper steps on and rejects stepping stones with either the left or right foot.

a curved path, namely a parabola. An overview of the motion made by the Hombo Batu jumper on the x and y axes, namely: the Hombo Batu jumper moves vertically upwards and the motion trajectory of the Hombo Batu jumper forms a parabolic curve.

The first stone jumping technique is sprinting. Sprinting is a movement in stone jumping that is done by running as fast as possible to get the highest speed before doing a repul-

FIGURE 10. Hombo Batu jumper bends one leg.

sion. Running is a movement activity. In its movement, the activities of running apply the attraction of the earth, friction, and air resistance. Running is done to increase the maximum strength used to perform the repulsive force. The changes in position in a certain time interval cause the speed.

The second stone jumping technique is to step on and reject the steppingstone with the left/right foot as shown in Fig. 9. When placing his feet on the steppingstone, the jumper swings his arms (hands swing from behind the body upwards) and each hand is clenched to get an additional push from the repulsion of the feet. The strongest repulsion with the feet is assisted by swinging the legs and swinging both arms forward towards the one shown in Fig. 10. Repulsion is a movement from horizontal to vertical speed that is done quickly and strongly to lift the body up in the air. If the jumper can combine the great initial speed with the repulsion force of the legs, he can bring his whole body up in the air. The jumper can bring the centre of gravity up, floating in the air towards the top for a long time. The stone jumper can apply its impulse $\vec{F}\Delta t = m\Delta\vec{v}$ to produce a large repulsion on the tara hoso so that it can move vertically up/forward through the Hombo Batu and this trajectory follows a curved pattern (curve), which can explain the parabolic motion, diagram shown in Fig. 8. Impulse causes the subject to move due to a change in momentum, so impulse is equal to a change in momentum. It should be noted that the jumper must run to gain a great deal of force for the repulsion and he requires proper incline. The greater the initial speed of the jumper, the greater the momentum force, *i.e.* the magnitude

FIGURE 11. Hombo Batu jumper floats in the air.

FIGURE 12. Hombo Batu jumper makes landing on both feet.

of the repulsion force of the jumper to move his entire body towards the top.

The last technique in Hombo Batu stone is the technique of how to get past the jumping stone without touching the top of the jumping stone by walking through the air, as shown in Fig. 11, and then landing behind the jumping stone "air phase" as shown in Fig. 12. In this movement, the jumper concentrates all of his mass around the waist and thighs. When the jumper reaches the highest point, the posture is sideways left/right and bent, namely hands to the body. When moving down, he extends both legs forward, inclines his body upwards towards the front, folds his legs at the front side, and focuses his attention on the landing. An object is said to have a parabolic motion if it moves through a curved path, *i.e*., a parabola, and there is no other force acting on it other than the earth's gravitational attraction. Parabolic motion is a motion that forms a certain angle to the horizontal plane. The trajectory of the Hombo Batu jumper when airborne forms a curve. However, it should be noted that the rock jumper is a human being and, unlike a bullet or an arrow that is fired, he will move along a parabolic trajectory and has only a gravitational force without any other force. The forces that exist are the force exerted by the stone jumper when doing rock jumps, namely the force of shifting the center of gravity or changing the center of mass. Initiating final foot contact by leaning away from the obstacle (rock) will be beneficial for the jump, but the main advantage of the curved approach is that it provides angular velocity [33].

Efficiency in stone jumping is highly dependent on optimal takeoff action. The horizontal speed mainly determines the takeoff action at the start of takeoff, the vertical speed at the end of the takeoff, and the takeoff duration [34]. At the end of the takeoff, the Hombo Batu jump is different from the high jump sport. In this Hombo Batu jump, the jumper lands in a standing position and supports his feet, not using a mat like in the high jump. Therefore, if a Hombo Batu jumper is trained in this jump, he needs to be trained with the right technique. Suppose the jumper initially learns a poor technique or is compromised. In that case, it will be very difficult for the jumper to lose that technique later when trying his or her personal best height, although later he or she is trained by a more knowledgeable trainer [35].

3.3. The implementation of Hombo Batu in science education

This Hombo Batu jumping tradition can be integrated into school learning materials or university lectures with two-dimensional parabolic motion/kinematics material. Teachers or lecturers can use cultural traditions as learning resources and trackers and spreadsheets as learning media. This method can concretize and contextualize two-dimensional kinematics material. This can change most students' perception that science is difficult and contains only calculations. The ethnoscience of the Hombo Batu jumping tradition in Nias is a fun and meaningful lesson. In addition to learning the science concept, students can learn to recognize and preserve their nation's culture.

The concept of parabolic motion can explain the motion of the Hombo Batu jumper when jumping on the Hombo stone, so that its movement forms a parabola with a speed that changes every time. Newton's laws will also be found in the motion of running, jumping and landing [4]. However, from some literature, it is not found how the explanation of the material content of the Hombo Batu movement, which is an ethnoscience in Nias, can be found. In addition, no literature on motion analysis using the tracker application exists. In 21st century learning, it is necessary to implement learning by collaborating with education, culture and technology so that it becomes an innovation in providing new learning experiences, strengthening learning styles and supporting the preservation of local and global culture.

An integrated curriculum with intercultural sensitivity development activities effectively develops students' intercultural sensitivity to scientific attitudes and behavior [23]. However, a weak understanding of ethnoscience can currently impact concern for the plurality of local cultures. The obstacle in doing science learning and the ethnoscience approach is that teachers have fewer skills, resulting in students not maximizing learning that respects the diversity of local culture and wisdom [24]. Therefore, teachers need to examine the local potential as learning materials in schools to internalize the character of global diversity in students.

This local potential in the form of regional culture can be used as a learning resource in teaching natural science. The knowledge the people found can be studied scientifically in teaching so that students can gain knowledge from the material being studied. Indigenous Knowledge System is a pedagogy that promotes cultural, social, and identity inquiry to legitimize the importance of learners' experiences and how educators can help them comprehend that their realities are socially created and will be reconstructed as time passes and exposure to new contexts increases [36]. To do reasoning, students need to have the knowledge needed to reason scientifically in certain contexts, including content knowledge, procedural knowledge, and epistemic knowledge [37]. Content knowledge ("knowing what") about scientific concepts refers to knowledge about the objects that become scientific reason and know-how. Procedural knowledge refers to knowledge of the rules, practices, and strategies that form the basis of the scientific reasoning process ("knowing how"). While epistemic knowledge concerns why scientific reasoning is important and how it contributes to building reliable scientific knowledge ("knowing why").

Learning science is an inherently active process in which students engage in scientific activities and build skills, knowledge, identity, and membership that affect their continued engagement [38]. Laboratory activities are important and must be carried out by students because these activities can shape students' understanding and experience in the learning process [39]. For science education, indigenous knowledge provides rich and authentic contexts. Simultaneously, it offers opportunities to reflect on nature and science. In current science teaching in the West aims to contribute to the development of more balanced and holistic worldviews, intercultural understanding, and sustainability [40]. By analyzing the Hombo Batu tradition in Nias using the tracker and by using technology, people can integrate culture into education. Tracker is a freeware program that analyses and simulates physical processes in mechanics using video captured images as input data [41]. The tracker output can be presented in a spreadsheet. Open-ended, problem-oriented, constructivist, investigative, discovery-oriented, active, and student-centered learning styles can all be facilitated by spreadsheets. They have several benefits: they are interactive; they provide constant feedback to changing data or formulae; they allow data, formulae, and graphical output to all be displayed on the screen at the same time; they give students a high level of control and ownership over their learning; they can solve complex problems and handle large amounts of data without the use of coding.

The use of information and communication technology produces literate individuals so that they can use information beneficial in life to solve problems, think, communicate, and spread benefits in society and also in cultural preservation [42]. Students that are familiar with software and know-how to navigate it will be able to develop computational thinking skills and learn how to approach and solve the real world [43]. Through the help of software, students can discover and learn through new ways of teaching and learning followed by a constructivist learning model [36].

Developing new pedagogies by optimally utilising new technologies in teaching and learning needs to be done [34]. However, the development and mediation of computer-assisted learning take time and effort, not only in the design of the material but also in updating it, otherwise, the material will quickly become irrelevant. Implementing culture in learning is certainly not an easy thing. It is necessary to carry out various more in-depth analyses of the learning needs of the digital era with the characteristics of local wisdom that will be used as a learning method [35]. A quality learning process will assist students in obtaining the expected learning outcomes, especially the ability to understand problems and find solutions with various strategies or methods so that they can easily adapt to the future [36].

Teachers can design problem-based learning, inquiry, and project-based learning to integrate ethnoscience into the experiment tracker. The use of trackers and spreadsheets can be integrated into lectures to help students contextualize the concept of parabolic motion and analyze it properly. This analysis tracker provides a very enjoyable "Eureka" experience for students because they are invited to connect abstract concepts and formulas in a contextual and real way so that learning deepens [8]. The results of using technology in the form of simulations are currently very easy to download for free and use in teaching and learning [45]. As a tracker, this application can be used as a learning medium so that students can learn more about parabolic motion. The results of the tracker analysis can also be presented in the form of a spreadsheet so that data from existing variables can be used for reasoning. Spreadsheets offer an easily accessible cross-disciplinary platform for the spread of numeracy and can encourage students to solve problems [46]. Ideas and explanations do not just 'emerge' from the data, but it is necessary to make assumptions and think imaginatively and creatively to take into account the data [47].

To support sustainable development education, science learning needs to be linked to the contextual realities of life [48]. One of them is by using the existing culture around our environment. Further research should be conducted to investigate whether there is an effect of footstools on maximal height by Hombo Batu jumpers. There is a lot of room for further progress in determining this rock jumping skill, namely the jumper's body movements to produce a 2-meterhigh rock jump with ease and to be able to return to a standing position without falling. Therefore, it is recommended that other researchers conduct further research by focusing more on the jump height produced by several stone jumpers using the same tara hoso stone.

Reveal motion videos analyzed using motion applications such as trackers, kinovea video motion analysis freeware and others can do many things, especially the significant performance differences between the high jump championships of gold, silver, and bronze medalists in the final events that may not be visible to the naked eye or by just viewing videos [49]. The Hombo Batu jumping technique can be used as a future study to be adapted to the field of high jump sports so that it can break world records. Therefore, the results of further studies related to Hombo Batu from Nias can be recommended topics. The Hombo Rock jump is similar to the high jump, which is one of the most technical and proving complex athletic activities, this proof can be divided into three parts: the approach run phase, the takeoff phase, and the flight phase [50].

The limitations in this article are, first, the researcher has not applied the development of this Hombo Batu directly in science learning activities. This is due to the limited time and cost of the researcher. Second, the Hombo Batu videos found on YouTube are limited and only jump once/do not repeat, so the analysis of Hombo Batu jumpers is only limited to one jump. To get a clearer picture, you can take pictures using a camera with a high resolution so that the frame rates are also high. Video quality determines the number of frames that can be extracted every second so that the larger the frame rates, the more the track record will show the movement of objects [42].

4. Conclusion

National culture can be used as a learning resource in the teaching that is packaged in an ethnoscience approach. Integrating ethnoscience into technology such as trackers and spreadsheets can also make it easier for students to analyze data to improve their thinking skills and get meaningful learning. This integration of local cultural traditions makes learning more contextual because the concept of parabolic motion in two-dimensional kinematics is easier to understand and at the same time it can introduce and preserve Indonesian cultures. Through this activity, teachers should be able to innovate and apply technology by integrating local culture into other materials. This paper succeeds in making parabolic motion visualization of Hombo Batu jumpers in Nias in ethnoscience-based learning to develop students' thinking skills analytically and numerically. Software Tracker and Spreadsheet are easier to use because they don't use a complicated programming language like GNU Octave. Trackers, GNU Octave and analysis on this spreadsheet can facilitate learning science on cognitive aspects and affective and psychomotor aspects. This article suggests that comparisons are still needed between simulations made with direct experiments to prove the results obtained, such as different footstools from those already tracked, comparing several Batu Hombo jumpers, or measuring three video recordings of one jumper using the same footstool.

Acknowledgments

We would like to thank the Science Education Study Programs of Sarjanawiyata Tamansiswa University and Yogyakarta State University, and Physics Education of the Education University of Indonesia for facilitating the publication of this article.

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