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Android Used in The Learning Innovation Atwood Machines on Lagrange Mechanics Methods

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Abstract: Android is one of the smartphone operating system platforms that is now widely developed in learning media. Android allows the learning process to be more flexible and not oriented to be teacher center, but it allows to be student center. The Atwood machines is an experimental tool that is often used to observe mechanical laws in constantly accelerated motion which can also be described by the Lagrange mechanics methods. As an innovative and alternative learning activity, Atwood Android-based learning apps are running for two experimental variations, which are variations in load in cart and load masses that are hung. The experiment of load-carrier mass variation found that the larger load mass in the cart, the smaller the acceleration experienced by the system. Meanwhile, the experiment on the variation of the loaded mass found that the larger the loaded mass, the greater the acceleration experienced by the system.

Keyword : android, atwood machines, Lagrange mechanics methods

1. Introduction

Education becomes increasingly important to ensure learners have the skills to learn, innovate, skills using technology and information media. Also, through education students are expected to work and survive by using skills for life (life skills). Three 21st century educational concepts have been adapted by the Ministry of Education and Culture of the Republic of Indonesia to develop a new curriculum. The three concepts are 21st Century Skills (Trilling & Fadel, 2009), Scientific Approach (Dyer et al., 2009), and Authentic Assessment (Wiggins & McTighe, 2011). Adaptation is do to achieve the conformity of the concept with the capacity of learners and the competence of educators and education personnel.

The development of learning media today is increasingly wide open along with the development of internet and mobile device technology. The findings of internet technology and the development of smartphone technology gave rise to the adoption of innovations in various areas of human life, one of which emerged the term mobile learning in the field of education. The term mobile learning (m-learning) refers to the use of handheld and mobile IT devices, such as phones, laptops, and tablet PCs. Mobile learning as an innovation allows the learning process to be more flexible and not oriented to be teacher center, but it allows to be student center.

Use of learning media in the learning process can generate interest, motivation, and stimulation of learning activities, even bringing psychological influences on learners. Mobile learning media gave a variety of learning application programs in the form of learning applications that can be accessed by all people. One of the smartphone operating system platforms developed in the development of learning media is the Android. The results of Shanmugapriya (2012), obtained that the m-learning environment for Android can improve teaching and learning process to be better in the m-learning environment with greater emphasis on the acquisition of knowledge learners. However, as the development, Android turned into a platform that is so fast in innovation.

The lack of media use and the dominant use of teacher-center delivery methods in traditional classrooms in Indonesia are common. Some schools are indeed starting to implement Information and Communication Technology (ICT) to support the learning process. However, the readiness of educators to utilize and integrate them into the learning process is still a big issue. Technical skills, time constraints, and lack of understanding of strategies to implement ICT-based learning process are still the reasons, suggests that educators do not yet have a high level of IT literacy. ICT has not been positioned as an integral part of a learning system capable of learning transformation.

Currently, students can explore the world and get the information sought. Technology and media can make learning easier and more practical. The teacher must have the readiness to enter into 'virtual society.' The orientation of learning is no longer directed to the development of academic ability alone, but also other learning abilities in the technological age, such as the ability to analyze, creativity, ethics, and become active knowledge producers.

Atwood engine is an experimental tool that is often used to observe the laws of mechanics in the motion of accelerated regularly. The Atwood plane is composed of two objects connected to a rope. If both mass objects are the same, both will be silent. However, if one is larger (e.g. $\boldsymbol{m_1 > m_2}$), then both objects will move towards $\boldsymbol{m_1}$. The pulling force is the weight of the object one. However, since the object two is also pulled down (by gravity), the resultant force of attraction is the weight of the object one minus the weight of the object two. The weight of the object one is $\boldsymbol{m_1 g}$ and the weight of the object two is $\boldsymbol{m_2 g}$. Resistance force is $\boldsymbol{(m_1 - m_2)g}$ moves both objects. Thus, the acceleration of the two bodies is the resultant force divided by the mass number of the two objects.

Atwood machine learning with Android is expected to be an alternative or innovation that can be used in learning activities other than used practice media.

2. Lagrange Mechanics

2.1. Lagrange Equation

Definition of Lagrange function:

$$L = T - U \ (1)$$

with:
L= Lagrange or Lagrangian function, T = kinetic energy, and U = potential energy

Steps to get the equations of motion (Warsono, 2016): (1) Determine the number of coordinates that describe the system; (2) Determine the kinetic energy of T; (3) Find the potential energy of U; (4) Determine the Lagrange $L = T - U$ function; and (5) Look for differential motion system based on Euler-Lagrange equation.

2.2. Application of Lagrange Method

An Atwood machine consisting of two mass $m$objects and M is connected by a long homogeneous string and passed to the pulley (Taylor: 2005). x is the vertical distance of the pulley to mass m as shown in Figure 1.

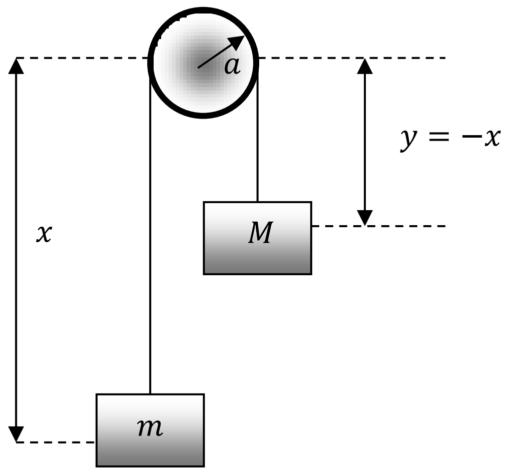

Figure 1. Atwood Machine

The kinetic energy of the system is:

$$T = \frac{1}{2}m\dot{x}^2 + \frac{1}{2}M\dot{x}^2 = \frac{1}{2}(m + M)\dot{x}^2 \ (2)$$

The potential energy of the system is:

$$U = -mgx - Mgy = -(m - M)gx \ (3)$$

So, Lagrangian:

$$L = T - U = \frac{1}{2}(m + M)\dot{x}^2 + (m - M)gx \ (4)$$

Lagrange equation defined by:

$$\frac{\partial L}{\partial x} = \frac{d}{dt}\frac{\partial L}{\partial \dot{x}} \quad (5)$$

Substitution L on the Lagrange equation, so that:

$$(M + m)\ddot{x}^2 = (m - M)g \quad (6)$$

$$\ddot{x} = \frac{(m - M)}{(m + M)} g \quad (7)$$

$\ddot{x}$ is the system acceleration. If $m > M$ then m will move down. Conversely, if $m < M$ then m will move up with a certain acceleration.

The display of the Android application that can be used in learning Atwood machine with Lagrange method shown in Figure 2.

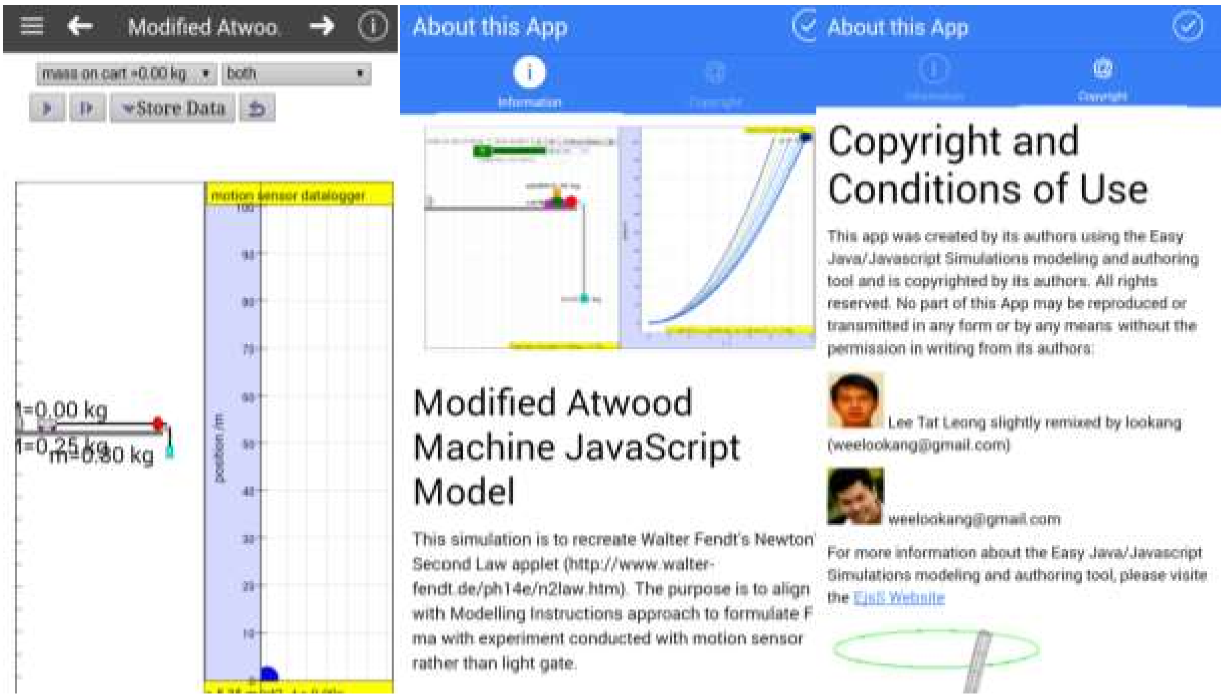

Figure 2. Android Atwood Machine App Display

Steps in the operation of the application can be explained as follows:

1. Download the Atwood2App app from Google PlayStore.
2. Perform an Atwood2App application installation.
3. Open the Atwood2App app.
4. Perform a virtual practicum of the Atwood Engine for:
   a. Variation of load mass in train (M)
      1) Set the mass of the load hung m at 0.30 kg.
      2) Selecting mass of load in the addM cart on the 0.00 kg.
      3) Touch the play button (▶) to start the animation.

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4) Looking at the measurement results of acceleration a, time t, and distance x.
5) Added experiments for load mass variations in the add$M$ cart respectively 0.05; 0.10; 0.15; 0.20; 0.25; And 0.30 kg by touching the store button.
6) Record the observations in the observation table.

b. Variations of loaded mass hanging (m)
1) Set the load mass in the train (add M) at the 0.00 kg figure.
2) Select the mass of the hanging load (m) at 0.05 kg.
3) Touch the play button (▶) to start the animation.
4) Looking at the measurement results of acceleration a, time t, and distance x.
5) Repeating the experiment for the variation of the hanging load mass (m) of 0.10 each; 0.15; 0.20; 0.25; 0.30; And 0.35 kg by touching the store button.
6) Record the observations in the observation table.

3. Result

a. Variation of load mass in train (add$M$)

App display with the variation of load mass in trains is shown in Figure 3.

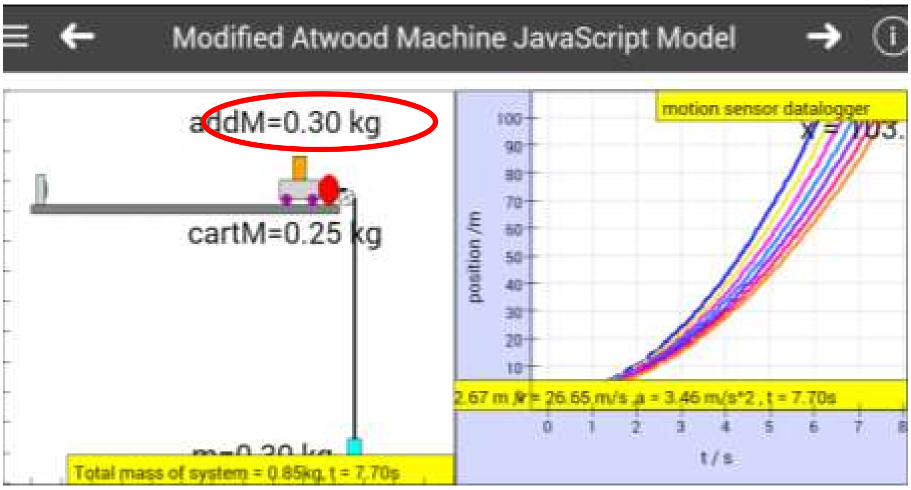

Figure 3. App Display with Variation of Load Mass in Cart(M)

The observed data of variations of load mass in cart is shown in Table 1.

Table 1. The Result of Observation of Mass Variation of Load in Cart (M)

No.	m (kg)	cart$M$ (kg)	add$M$ (kg)	cart+add M (kg)	$m+M$ (kg)	a (m/s^2)	t (s)	x (m)
1.	0.30	0.25	0.00	0.25	0.55	5.35	6.25	104.33
2.	0. 30	0.25	0.05	0.30	0.60	4.90	6.47	102.67
3.	0. 30	0.25	0.10	0.35	0.65	4.52	6.74	102.67
4.	0. 30	0.25	0.15	0.40	0.70	4.52	6.74	102.67

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No.	m (kg)	cart$M$ (kg)	add$M$ (kg)	cart+add M (kg)	$m+M$ (kg)	a (m/s^2)	t (s)	x (m)
5.	0. 30	0.25	0.20	0.45	0.75	3.92	7.24	102.67
6.	0. 30	0.25	0.25	0.50	0.80	3.67	7.47	102.67
7.	0. 30	0.25	0.30	0.55	0.85	3.46	7.70	102.67

Based on the data in Table 1, it can be seen that the greater the load mass in the train M, the smaller the acceleration experienced by the system. The graph of mass load relation in cart$M$ to acceleration can be shown in Figure 4.

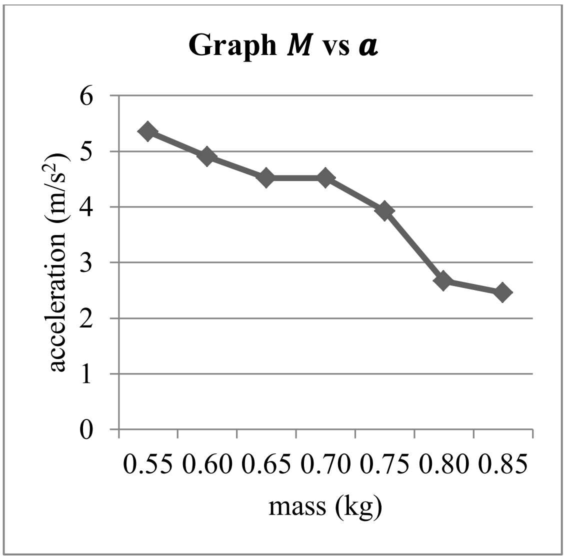

Figure 4. Graph of Mass Relation to Acceleration on Mass Variation of Cartloads

b. Variation of loaded mass hanging (m)

App display of the hanging load mass variation is shown in Figure 5.

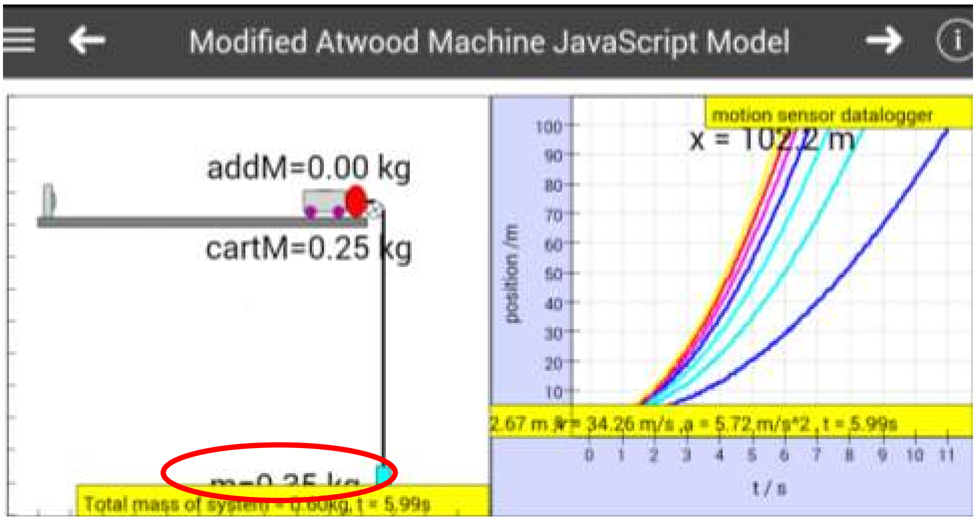

Figure 5. Mass Variation Data Display Loaded Mass Hanging (m)

The observed data on the variation of the hanging load mass is shown in Table 2.

Table 2. The Result of Observation of Mass Variation of Loaded Mass Hanging

No.	m (kg)	cart$M$ (kg)	add$M$ (kg)	cart+add M (kg)	$m+M$ (kg)	a (m/s^2)	t (s)	x (m)
1.	0.05	0.25	0.00	0.25	0.30	1.63	11.21	103.67
2.	0.10	0.25	0.00	0.25	0.35	2.80	8.56	102.67
3.	0.15	0.25	0.00	0.25	0.40	3.67	7.47	102.67
4.	0.20	0.25	0.00	0.25	0.45	3.92	7.24	102.67
5.	0.25	0.25	0.00	0.25	0.50	4.90	6.47	102.67
6.	0.30	0.25	0.00	0.25	0.55	5.35	6.25	102.67
7.	0.35	0.25	0.00	0.25	0.60	5.72	5.99	102.2

Based on the data in Table 2, it can be seen that the greater the mass of the load hung m, the greater the acceleration experienced by the system. The graph of mass load relation is hanging m to acceleration can be shown in Figure 6.

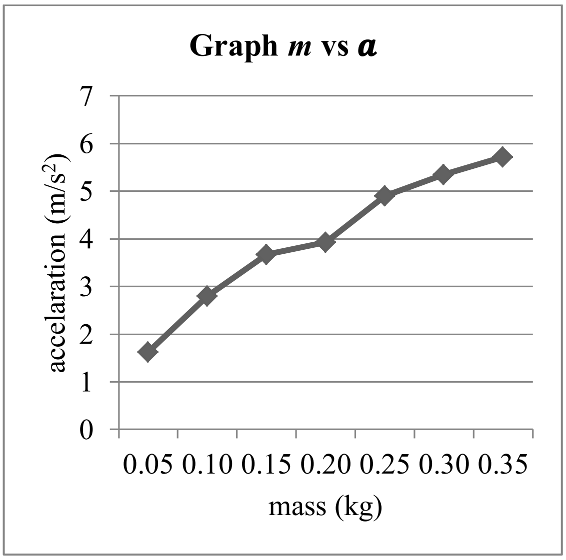

Figure 6. Graph of Mass Relation to Acceleration on Mass Variations of Hanged Loads

4. Conclusion

This Android-based Atwood machine learning app contains experiments for two variations, namely variations in load mass in cart and load masses that are hung. In the experimental variation of load mass in the cart, it was found that the larger the load mass in the cart, the smaller the acceleration experienced by the system. Meanwhile, in the experiment on the variation of the loaded mass, it is found that the larger the loaded mass, the greater the acceleration experienced by the system. This application can be used as an innovation or alternative learning activities Atwood machine with Lagrange mechanics method.

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