

PAPER • OPEN ACCESS

Study of Kinematics and Dynamics of motion at Semanggi Bridge Jember, Indonesia as a contextual in Physics Learning

To cite this article: S Astutik *et al* 2021 *J. Phys.: Conf. Ser.* **1832** 012033

View the [article online](#) for updates and enhancements.

You may also like

- [EVOLUTION OF THE GLOBAL TEMPERATURE STRUCTURE OF THE SOLAR CORONA DURING THE MINIMUM BETWEEN SOLAR CYCLES 23 AND 24](#)
Federico A. Nuevo, Zhenguang Huang, Richard Frazin et al.
- [Estimation of Fractional Surface Coverage of Particles for Oxide CMP](#)
Wonseop Choi, Seung-Mahn Lee, Jeremiah Abiade et al.
- [Studies on spatial modes and the correlation anisotropy of entangled photons generated from 2D quadratic nonlinear photonic crystals](#)
X W Luo, P Xu, C W Sun et al.



ECS
The
Electrochemical
Society
Advancing solid state &
electrochemical science & technology

DISCOVER
how sustainability
intersects with
electrochemistry & solid
state science research

Study of Kinematics and Dynamics of motion at Semanggi Bridge Jember, Indonesia as a contextual in Physics Learning

S Astutik^{1*}, Supeno¹, S H B Prastowo¹, T Prihandono¹ and S Bektiarso¹

¹Physics Education Department, University of Jember, Jember, Indonesia

E-mail: tika.fkip@unej.ac.id

Abstract. Some facts show that students often have difficulty in studying the kinematics and dynamics of motion. To overcome these problems, it takes learning experience that can help students build their knowledge about physics. One way is to connect the material physics with contextual phenomena because basically everything in nature can be learned based on physics studies. Semanggi Bridge located in Jember district is a connecting bridge that has a unique shape with three paths in the form of down, circle, and straight path. The studies results of kinematics and dynamics of motion on sloping and flat trajectories obtain physics quantities, ie position, distance, displacement, speed, velocity, kinematics and dynamics of motion on circular paths obtain physics quantities, ie angular position, angular velocity, angular acceleration, centripetal acceleration, centripetal force, and maximum speed. The studies results of kinematics and dynamics of motion can be used as a basis for designing contextual learning resources such as subject matter, sample questions, laboratory activities, and exercise questions related to contexts of physical phenomena.

1. Introduction

Physics is a part of science that can be viewed as a way of thinking to understand and master of nature. Physics studies the natural phenomena of matter or matter in the sphere of space and time which can be explained in various quantitative calculations. Physics is divided into several areas of study, one of which is the field of mechanics. Mechanics is a part of physics that studies the motion of objects, concepts of force, and energy is interconnected.

Mechanics is divided into two kinds, there are kinematics and dynamics. Kinematics studies the motion of objects regardless of the cause of motion. The kinematics of motion includes one of the early topics taught in physics learning in high school. The concept of kinematics discusses the position, speed, and acceleration that accompanied the time [24]. [18] states that dynamics discusses the motion of objects or changes in motion along with the cause, ie force because the mass of an object affects motion. The subject of motion dynamics is more easily understood by the students if the understanding of motion kinematics concept is correct. In other words, it can be stated that the two materials are interconnected. This is in accordance with the results of research of [17] which explains that the game of angry bird can be studied based on kinematics studies and dynamics of motion.

The existence of interrelationship between kinematics subject matter with dynamics requires students to have a correct understanding of the initial concept. According to [3], phenomena experienced in everyday life is an experience that made the initial concept for students. Contextual



learning experiences can be used to help build the correct initial concept for students so that a physics review of important contextual phenomena is included in the lesson. [14][7] stated that the utilization of contextual learning resource in physics learning can increase the learning activity, including in good category, the result of learning cycle I is in enough category, and the learning outcomes in cycle II are in a good category.

Students still often find problems in learning kinematics and dynamics. This fact is supported by research by [5] which states that students have problems in understanding the graphs of kinematics although they can be mathematically calculated. [26] stated that the success rate of students in working on problems regarding Newton's law of motion is still unsatisfactory. The research result of [13] shows that there is some misunderstanding about the matter of motion and force, that is, the movement of an object is always caused by force, no force acts on the object, the force affects the velocity of the object, the force of gravity only acts on the falling object, and when the object is thrown up the force comes from the hand that throws the object.

Research in Indonesia by [10] explains that students have misconceptions on the material of mechanics of motion, especially for kinematics of straight motion of 32.50%, the dynamic of motion of 47.50%, the motion blend of 50.74%, the circular motion of 48.94%, and the friction of 40.08%. Other facts show that problems in learning kinematics and dynamics are obtained from the results of the nationalexamination lesson year 2015/2016. The nationalexamination 2016 in Jember district was attended by 62 senior highschool but only 51 senior highschools have class of naturalscienceprogram. [16] [11] explains that the mastery of high school students in Jember district in working on the nationalexamination, especially on measurement and kinematics of 45.58% and on material dynamics of 60.63%. This condition shows that the ability of high school students in Jember district on kinematics and dynamics is still unsatisfactory.

Textbooks as a teaching material is one of the supporting in physics learning, but sometimes in physics textbook also have problems. [18] [4]explain that there are misconceptions in the textbook of the students on the kinematics of motion of 7.2% and on the dynamics of motion of 7.2%. Furthermore, based on interviews with several physics teachers in several schools in Jember district about textbooks used in physics learning, almost all of them use the same book. Basically, the textbook has been loaded with material that includes contextual phenomena, questions, and practice questions. But the contextual phenomena contained in textbooks have not been contextual phenomena that are close to student life.

Some researchers have conducted research related to the materials of contextual teaching to help students understand the learning of kinematics and dynamics. [20] developed a web-based contextual physics module and the results of his research indicate that web-based contextual modules are effectively used as learning facilities for senior high school students. [4] developed a contextual physics module to improve physics learning outcomes and the results showed that the average score of pretest was 30.21 and posttest score of 75.17. [3] [12]developed contextual-based handouts on dynamics of rotational and equilibrium and based on the results of his research show that students gave the positive responses after learning to use contextual-based handouts.

Some of the studies have shown that there is an increase in learning outcomes when learning is done using contextual physics teaching materials, but the contextual phenomena created in the teaching materials are not really phenomena that are close to the student's life or characterize a contextual phenomena in an area close to the place student life. Jember regency has a well-known bridge and connects Bengawan Solo street with Bedadung street. The road on this Semanggi Bridge is a sloping, circular, and straight track that can be studied its kinematics and dynamics of motion. So, to add the reference in designing contextual teaching and learning material and really close to the student's life, it is done by studying the contextual phenomena in Jember regency Indonesia, that is a study of kinematics and the dynamics of motion on the Semanggi bridge of Jember district. The results of this study are expected to be used as a basis for developing a contextual learning resource of physics.

2. Methods

2.1. Kind of Research

The type of this research is analytical descriptive research. According to [19], An analytical descriptive method is a method that serves to describe or give an overview of the object under study through the data or samples that have been collected as is by doing analysis and make conclusions that apply to the public. So in this study used analytical descriptive research method to analyze and describe data from contextual phenomena related to kinematics and dynamics of motion at Semanggi Bridge Jember as a source of physics learning in senior high school.

2.2. Time and Place of Study

The study of kinematics and the dynamics of motion on the Semanggi bridge of Jember district was conducted in two places. First, make observations and measurements of data on the Semanggi Bridge. The trajectory is divided into 3 parts (Figure 1), ie the Bengawan Solo street in the form of a sloping track, a circular path that connects Bengawan Solo street with Bedadungstreet, and Bedadung street in the form of a straight path. Second, analyze the data of physics quantities obtained from the measurement results in Physics Laboratory of Basic of Physics Education of Jember University. The time of research implementation in the even semester of academic year 2018/2019.



Figure 1. The trajectory on Semanggi bridge with 3 segments.

2.3 Data collection technique

Data collection methods were conducted through primary data measurement activities obtained directly in the field and through secondary data obtained from the Office of Highways Jember and Google Earth applications on personal computers (PCs). On track 1 (sloping track) data are collected, ie length of trajectory, the altitude of location, speed, the slope of trajectory, and the time it takes the vehicle to cross the trajectory. In track 2 (circular path) the data is collected, ie the length of the trajectory, the radius of the circle on the trajectory, the height of the location, the speed of the vehicle crossing the trajectory, the angle and the time it takes the vehicle to cross the trajectory. In path 3 (straight path) data are collected, ie the length of the trajectory, the speed of the vehicle passing through the trajectory, and the time it takes the vehicle to cross the trajectory. Primary data of measurement results are then cross-checked with secondary data from Bina Marga Office of Jember district and Google Earth application.

Tools and materials used in this study are android altimeter digital applications, long gauges, motorcycles, stopwatch, and personal computer applications (PC) Google Earth. Usefulness and explanation of the tools and materials are as follows:

1. Digital altimeter uses android applications that can be used to measure the altitude of location. Digital altimeter used in this research is equipped with GPS (Global Positioning System) triangulation. This application can work offline or online, better used online to improve the accuracy of data obtained.
2. The long measuring instrument is used to measure the length of the path between points that have been determined.
3. The stopwatch is used to measure the time it takes for a vehicle to traverse any specified point.
4. Motorcycles are used to determine the speed of a vehicle that crosses every point that has been determined. The motorcycle used in this research is Honda / NF 125 SD with mass 107 kg.
5. Google Earth is an application used on personal computers (PCs) and works online. Google Earth is a virtual globe app created by Keyhole, Inc. This application maps the earth from the superimposition of images obtained from the collection of satellite mapping, aerial photography, and a 3D GIS globe. The resolution of the displayed image is high enough to even display the object in detail such as buildings, roads, and houses. From this application can know the distance from one place to another, the height of a place, the geographical position of a place, and many other features.

2.4 Data analysis technique

The measurement data in the field is then analyzed to assess the kinematics and dynamics of motion of each predetermined trajectory. The results of this study are then used to describe the design of contextual learning resources in accordance with learning in senior highschool. Description of kinematics and dynamics of motion as the basis for the design of physics learning resources is divided into three sections in accordance with the three predetermined trajectories on the Semanggi Bridge Jember district. The first is a description of kinematics and the dynamics of the object's straight motion on the path of 1 Semanggi Bridge, which is a sloping trajectory. The second source of learning design is the description of kinematics and the dynamics of circular motion on the path 2 of Semanggi Bridge in the form of circular path. The design of the third learning resource is a description of kinematics and the dynamics of the straight motion of the object on the path 3 of Semanggi Bridge in the form of a straight path.

3. Result and discussion

Semanggi Bridge in Jember district is a bridge connect Bengawan Solo street and Bedadung street. Semanggi Bridge is located in Summersari sub-district, close to Jember city. Unique trajectory shape, consisting of three forms of trajectory, ie the way down, circular, and straight so that it becomes characteristic of the Bridge Semanggi. If the vehicle passes from the front office of the Ministry of Religious Jember district which is located on the Bengawan Solo street, then the trajectory that passes in a sequence is the incline, the circle, and the last is the straight trajectory. Vehicles crossing the Semanggi Bridge can be studied kinematics and dynamics of motion. The vehicles used in this research are Honda / NF 125 SD motorcycle with mass 107 kg and passenger mob of 42 kg motorcycle, so total mass is 149 kg.

3.1. Study of Kinematics and Dynamics Motion on Trajectory 1

Trajectory 1 Semanggi Bridge is along the Bengawan Solo street starting from point A which has a height of 98 m to point B (Fig. 2). Geographical position of point A is at $8^{\circ}10'5,46''$ LS and $113^{\circ}42'37,23''$ BT and point B is at $8^{\circ}10'2,79''$ LS and $113^{\circ}42'26,91''$ BT. The trajectory 1 is an incline with a path length of 297.06 m and a slope angle of 19.26° . Data acquisition on trajectory 1 is carried out by applying the principle of straight-line motion. The illustration of free body diagrams as the vehicle passes through the path is shown in Figure 2.



Figure 2. Path 1 is a descending path.

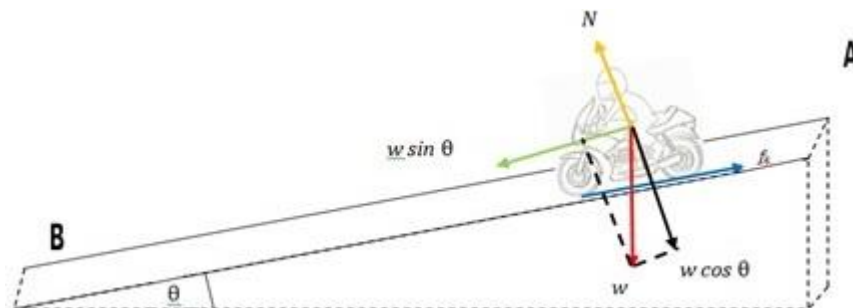


Figure 3. Illustration of trajectory 1 at Semanggi bridge Jember district.

The data obtained on trajectory 1 are:

- 1) Motorcycle mass(m_1) : 107 kg
- 2) Riders' mass(m_2): 42 kg
- 3) Length of track(s) : 297.06 m
- 4) Initial speed(v_0) : 20 km/h = 5.56 m/s
- 5) Final speed(v_t) : 40 km/h= 11.11 m/s
- 6) Elevation of A (h_A) : 98 m
- 7) Travel time(Δt) : 54.3 s

When the motorcyclist passes through the 1st point from point A to point B with an initial speed of 20 km/h or equivalent to 5.56 m/s without braking to reach point B with a final speed of 40 km/h or equivalent to 11.11 m/s, then the kinematics and dynamics of motion that can be studied are as follows in Table 1.

Table 1. Data of kinematics and dynamics of motion

Data	Result
Displacement	297.06m
Distance	297.06m
Velocity (v_0)	5.56m/s
Velocity (v_t)	11.11m/s
Acceleration	0.1m/s ²
Force	137.84N

3.2. Study of Kinematics and Dynamics Motion on Trajectory 2

Trajectory 2 of Semanggi Bridge starts from the last point of the trajectory 1 to the end of the circular path. Path 2 is divided into three sections as shown in Figure 4 and 5. The first part starts from point A to point B with position A at $8^{\circ}10'2,79''$ LS and $113^{\circ}42'26,91''$ BT, position of point B at $8^{\circ}10'1,51''$ LS and $113^{\circ}42'26,03''$ BT. The second part of path 2 starts from point B to point C with position B at $8^{\circ}10'1,51''$ LS and $113^{\circ}42'26,03''$ BT, and position of point C at $8^{\circ}10'0,93''$ LS and $113^{\circ}42'27,54''$ BT. The third part of path 2 starts from point C to point D with position of point C at $8^{\circ}10'0,93''$ LS and $113^{\circ}42'27,54''$ BT, and position point D at $8^{\circ}10'2,56''$ LS and $113^{\circ}42'28,48''$ BT. The measured data on track 2 is shown in Table 2.



Figure 4. The trajectory 2 is a circular path.

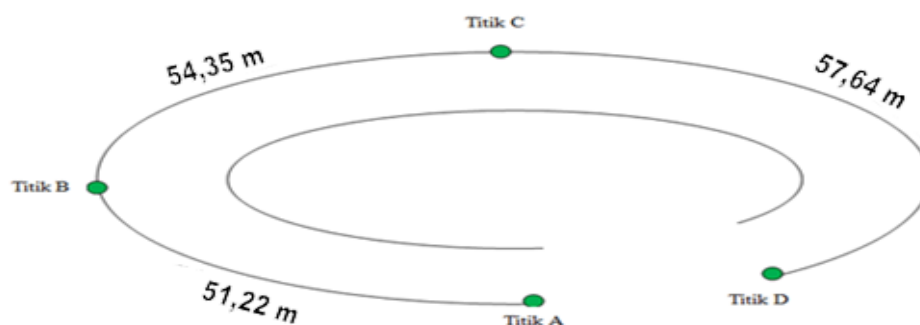


Figure 5. Illustration of trajectory 2 of Semanggi Bridge Jember district.

Table 2. The measurement data on trajectory 2 (circular path).

Trajectory	Lenght of trajectory (m)	Initial speed (km/h)	Final speed (km/h)	Initial time (s)	Final time (s)	Radius (m)	Height the right side of the track (m)	Height the left side of the track (m)
1 (A-B)	51.22	20	20	0	9.2	33.02	82	83
2 (B-C)	54.35	20	20	0	9.8		83	85
3 (C-D)	57.64	20	20	0	10.4		85	86

a. Motion from point A to point B

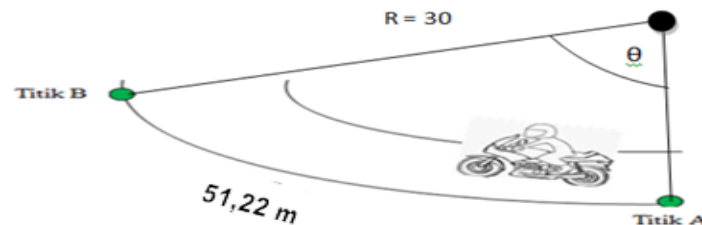


Figure 6. Illustration of motion from point A to point B at trajectory 2.

Data of measurement result at point A to point B in trajectory 2:

- 1) Motorcycle mass (m_1) : 107 kg
- 2) Rider mass (m_2): 42 kg
- 3) Length of track (s) : 51.22 m
- 4) Speed (v) : 20 km/h = 5.56 m/s
- 5) Difference in altitude (Δh) : 1 m
- 6) Travel time (Δt) : 9.2 s
- 7) Radius of track : 33.02 m
- 8) Road width (n): 10 m

When a motorcyclist crosses the path 2 from point A to point B with a constant speed of 20 km/h or equivalent to 5.56 m/s, then the kinematics and the dynamics of circular motion at point A to point B that can be studied is as follows:

- a) Angle position (θ) : $\theta = 1.5$ rad
- b) Liniervelocity (v) : $v = 5.56$ m/s
- c) Anguler velocity (ω) : $\omega = 0.17$ rad/s
- d) Linieracceleration (a) : $a = 0.6$ m/s²
- e) Anguler acceleration (α) : $\alpha = 0.018$ rad/s²
- f) Centripetalacceleration (a_s) : $a_s = 0.94$ m/s²
- g) The bankingangle $\beta = 5.73^\circ$
- h) Force (F) :
 - Motorcycle mass (m_1) : 107 kg
 - Rider mass (m_2) : 42 kg
 - Total mass (m_{total}) : $F = 140.06$ N
 - i) Maximum speed on banked road (v_{maks}) : $v_{maks} = 5.7$ m/s

b. Motion from point B to point C



Figure 7. Illustration of motion from point B to point C at trajectory 2.

Data of measurement result at point B to point C in trajectory 2:

- 1) Motorcycle mass (m_1) : 107 kg
- 2) Rider mass (m_2): 42 kg
- 3) Length of track(s) : 54.35 m
- 4) Speed (v) : 20 km/h = 5.56 m/s
- 5) Difference in altitude(Δh) : 2 m
- 6) Travel time (Δt) : 9.8 s
- 7) Radius of track : 33.02 m
- 8) Road width (n): 10 m

When a motorcyclist crosses the path 2 from point B to point C with a constant speed of 20 km/h or equivalent to 5.56 m/s, then the kinematics and the dynamics of circular motion at point B to point C that can be studied is as follows :

- a) Angle position (θ) : $\theta = 1.6$ rad
- b) Liniervelocity (v) : $v = 5.56$ m/s
- c) Anguler velocity (ω) : $\omega = 0.17$ rad/s
- d) Linieracceleration (a) : $a = 0.57$ m/s²
- e) Anguler acceleration (α) : $\alpha = 0.017$ rad/s²
- f) Centripetalacceleration (a_s) : $a_s = 0.94$ m/s²
- g) The banking angle $\beta = 11.5^\circ$
- h) Force (F) :
 Motorcycle mass (m_1) : 107 kg
 Rider mass (m_2): 42 kg
 Total mass (m_{total}) : $m_{total} = 149$ kg and $F = 140.06$ N
- i) Maximum speed on banked road (v_{maks}) : $v_{maks} = 8.1$ m/s

b. Motion from point C to point D

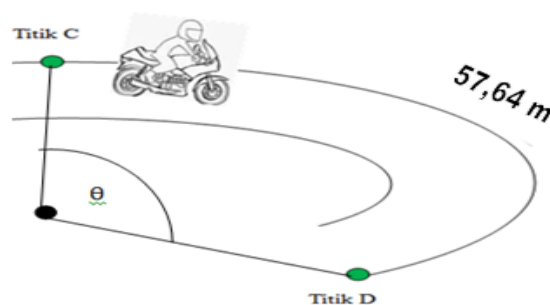


Figure 8. Illustration of motion from point C to point D at trajectory 2.

Data of measurement result at point C to point D in trajectory 2:

- 1) Motorcycle mass (m_1) : 107 kg
- 2) Rider mass (m_2): 42 kg
- 3) Length of track (s) : 57.64 m
- 4) Speed (v) : 20 km/h = 5.56 m/s
- 5) Difference in altitude(Δh) : 2 m
- 6) Travel time (Δt) : 10.4 s
- 7) Radius of track : 33.02 m
- 8) Road width (n): 10 m

When a motorcyclist crosses the path 2 from point C to point D with a constant speed of 20 km/h or equivalent to 5.56 m/s, then the kinematics and dynamics of circular motion at point C to point D that can be studied is as the following:

- a) Angle position (θ) : $\theta = 1.7$ rad
- b) Linier velocity (v) : $v = 5.54$ m/s
- c) Angular velocity (ω) : $\omega = 0.17$ rad/s
- d) Linier acceleration (a) : $a = 0.53$ m/s²
- e) Angular acceleration (α) : $\alpha = 0.016$ rad/s²
- f) Centripetal acceleration (a_s) : $a_s = 0.93$ m/s²
- g) The banking angle $\beta = 5.73^\circ$
- h) Force (F) :
 - Motorcycle mass (m_1) : 107 kg
 - Rider mass (m_2) : 42 kg
 - Total mass (m_{total}) : $F = 138.57$ N
- i) Maximum speed on banked road (v_{maks}) : $v_{maks} = 5.7$ m/s

3.3. Study of Kinematics and Dynamics Motion on Trajectory 2

The 3rd trajectory on the Semanggi Bridge path starts from the end of track 2 to the end of the bridge (Fig. 9). This trajectory is a straight path with a track length of 115.06 m. The position of point A at $8^\circ 10' 2.56''$ LS and $113^\circ 42' 28.48''$ BT, position point B at $8^\circ 10' 2.36''$ LS and $113^\circ 42' 24.53''$ BT. Data acquisition on trajectory 3 is performed by applying the principle of straight motion, ie a moving motor with a fixed speed (Fig. 10).



Figure 9. Trajectory 3 is a straight flat road.

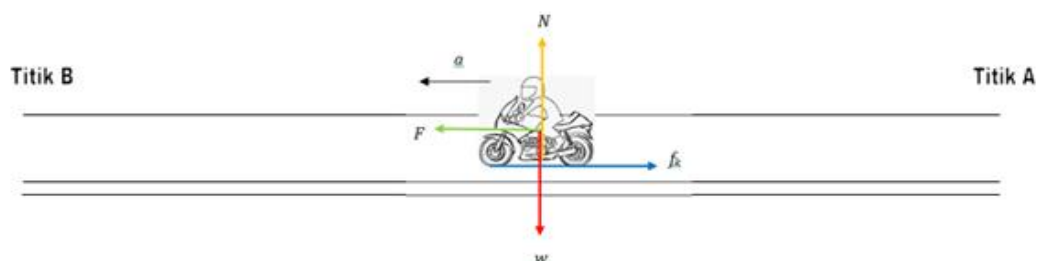


Figure 10. Illustration of third trajectory 3 of Semanggi Bridge Jember district.

The data obtained on trajectory 3 are:

- 1) Motorcycle mass (m_1) : 107 kg
- 2) Rider mass (m_2) : 42 kg

- 3) Length of track(s) : 115.06 m
- 4) Initial speed(v_0) : 20 km/h = 5.56 m/s
- 5) Final speed(v_t) : 20 km/h = 5.56 m/s
- 6) Travel time(Δt) : 20.7s

When a motorcyclist crosses the path 3 from point A to point B with a constant speed of 20 km/h or equivalent to 5.56 m/s to reach point B, the kinematics and dynamics of motion that can be studied are as follows:

- a) Displacements = 115.06 m
- c) Velocity

Because the displacement equal to the distance traveled then the speed is equal to the speed of the motorcycle.

$$v_0 = 5.56 \text{ m/s} \quad v_t = 5.56 \text{ m/s}$$

- e) For straight motion with constant speed:

Displacement at t , suppose $t = 10 \text{ s} = 55.6 \text{ m}$

- f) Force

Motorcycle mass(m_1) : 107 kg

Rider mass(m_2) : 42 kg

Total mass (m_{total}) : $m_{total} = 149 \text{ kg}$

The resultant force is zero because a motorcycle is moving with constant speed.

Kinematics and dynamics of motion include materials taught in physics learning at senior high school. From several studies, students have a problem in learning of kinematics and dynamics of motion. [15] [25] stated that one of the factors causing such misunderstanding is that Indonesian students are poorly trained in solving contextual problems, reasoning, and creative thinking in solving problems. This fact is also supported by the results of national exam of senior high students, especially in Jember district on the measurement and kinematics of 45.58% and the dynamics of 60.63%. To overcome these problems required an understanding of the initial concept that can help students more easily study the kinematics and dynamics of motion. [21] explains that the phenomena in everyday life are an experience that made the initial concept for students. Phenomena in everyday life are everything that is easy to find, easy to touch, easy to do or so-called contextual phenomena.

Several previous studies have proven that physics learning using learning resources or contextual teaching materials can help students to more easily understand the material. [20] study of web-based contextual physics module was able to demonstrate the effectiveness of learning for students. Research from [6] on contextual physics module can improve student physics learning from pretest score of 30.21 (before using contextual physics module) into posttest score of 75.17 (after using contextual physics module). [1] research on context-based physics handouts was able to get positive responses from students after use in physics learning.

Kinematics and dynamics of motion study all moving objects. In the daily life of moving objects often encountered are vehicles that pass on the highway. Jember regency is a district with 31 districts, one of which is Summersari subdistrict located not far from Jember city. Summersari District has a bridge which is quite famous as the Semanggi Bridge. Semanggi Bridge is a bridge that connects between Bengawan Solo street with Bedadung street. This bridge is unique because it consists of three kinds of trajectory, ie incline, circle, and straight. Because the bridge is easy to find in everyday life, especially by students in Jember district, vehicles crossing this path can be used to help students more easily understand the material of kinematics and dynamics of motion as outlined in the form of a contextual learning resource.

Learning resources are one component in physics instruction that allows students to gain knowledge. [2] reveals the resource of learning provides a learning experience and without learning resources, it is impossible to do the learning process well. Resource of learning consists of several types, one of which is the resource of learning from the environment. [8] explains that the contextual learning resource is not only media in the classroom, but a broad source. [9] argues that contextual

approaches invite students to relate material taught to real-world situations and to encourage students to make connections between their knowledge and application in their daily lives so that students will experience meaningful learning. From contextual learning sources, not only emphasizes the mastery of the material but also emphasizes that students are able to think critically, analyze, and convey the opinions of any material associated with the real situation. So the form of the design of this learning resource in the form of materials, mini laboratories that can be done alone by students with tools and materials that are easily found in everyday life, examples of problems and exercise questions that invite students to be more critical thinking.

The shape of trajectory on the Semanggi Bridge is divided into three, ie trajectory 1 is the incline, the trajectory 2 is the circle, and the trajectory 3 is straight. The data obtained from special conditions ie the road is not slippery and the weather is not raining. If a motor vehicle passes through the Semanggi Bridge, it can be measured in the length of the trajectory, speedometer shows the speed when crossing this line, the height of the location is used to measure the angle of the road, and the mass of the vehicle with the mass of passengers is used to calculate the force that works.

Trajectory 1 on the Semanggi bridge Jember district is a sloping trajectory. The track has a length of 297.06 m with a slope angle of 19.26° . From trajectory 1, this can be known quantities in kinematics and dynamics of motion. According to the physical materials taught in senior high school, then from trajectory 1 is obtained distance, displacement, speed, acceleration, mass, and force which works when the motorcycle moves. So, from the quantities obtained on trajectory 1, this can be used to design the resource of physics learning which is one of the contextual phenomena in Jember district.

Trajectory 2 on the Semanggi bridge Jember district is the actual trajectory is not a perfect circle, just to facilitate the understanding of the material then the trajectory 2 is considered as a circle. According to the physics material in senior high school, trajectory 2 is obtained by quantity in kinematics and dynamics of circular motion, ie angle position, angular velocity, angular acceleration, centripetal acceleration, road bend angle, force, and maximum speed at the bend. So, from the magnitudes obtained on trajectory 2, this can be used to design the resource of physics learning which is one of the contextual phenomena in Jember district.

Trajectory 3 on the Semanggi Bridge Jember district is a straight line trajectory with a track length of 115.06 m. According to the physics material in senior high school, especially kinematics and dynamics of straight motion, then get the amount of physics like the distance traveled by motorcycle, displacement of motorcycles, motorcycle speed, motorcycle velocity, and motorcycle acceleration. So, from the quantities obtained on trajectory 3, this can be used to design the resource of physics learning which is one of the contextual phenomena in Jember district.

The design of contextual learning resources of kinematics and dynamics of motion consists of a description of kinematical and the dynamics of straight motion and circular motion that is adapted to the material of physics in senior high school. The concept of physics explained through contextual phenomena can help students understand the material easily. The teacher can determine the concept of physics to be taught to students and how to teach students to understand the material [22] So, the design of this learning resource can be used as a reference or better developed by teachers for learning kinematics and dynamics of motion in senior high school in the form of textbooks and student worksheets. Textbooks can contain materials, mini labs, practice questions that focus more on the level of critical thinking. While the student worksheets can be developed contains some activities using real tools and materials. Learning that comes with real tools and materials is expected to improve students' ability to understand concepts, skillful use of tools, observe natural phenomena, record observational data, conclude, follow up and apply the learned concepts [23]. Therefore, the design of learning resources from this research can be used as a reference or developed again by teachers and other researchers to explain the concept of physics using contextual phenomena that are very close to the student environment.

4. Conclusion

Based on the study results of kinematics and dynamics of motion for motorcycle crossing Semanggi bridge Jember Indonesia, it can be concluded several things as follows:

1. Each section of the trajectory on Semanggi bridge Jember can be obtained physics quantities that is really contextual, such as length of trajectory, travel time, speed, the angle of the road, and the mass of objects. Then the data can be used to design a learning resource tailored to the needs in learning the kinematics and dynamics of motion.
2. The design of learning resources consists of kinematics and dynamics of motion straight or circular motion equipped with a sample of problems, mini laboratories with tools and materials that are easy to find in everyday life, and practice questions with the level of critical thinking so that students are able to analyze and convey opinion scientifically.
3. Learning resources are still in the form of design, so that can be used as a reference and can be developed into textbooks or student worksheet by further researchers.

Acknowledgment

We gratefully acknowledge the support from SMAN 3 Jember and Physics Education Departmen, Faculty of Teacher Training and Education- University of Jember

References

- [1] Apriani, H., Muniarti, and A. Pasaribu. 2016. Pengembangan handout dinamikarotasi dan kesetimbangan bendegarberbasiskontekstual kelas XI IPA SMA. *Jurnal Inovasi dan Pembelajaran Fisika*. 3(2), p. 1-6.
- [2] Astutik, S., and Prahani, B. K. 2018. The Practicality and Effectiveness of Collaborative Creativity Learning (CCL) Model by Using PhET Simulation to Increase Students' Scientific Creativity. *International Journal of Instruction*, 11(4), 409-424.
- [3] Astutik, S., M A Mahdiannur, Suliyannah, and B K Prahani. 2018. Improving science process skills of junior high school students through the implementation of collaborative creativity learning (CCL) model in physics learning. *Journal of Physics: Conference Series*. IOP Conf. Series: Journal of Physics: Conf. Series 1171(2019) 012006
- [4] Astutik S and Prahani BK. 2018 Developing Teaching Material for Physics Based on Collaborative Creativity Learning (CCL) Model to Improve Scientific Creativity of Junior High School Students. *Jurnal Penelitian Fisika dan Aplikasinya (JPFA)*.; 8(2): 91-105. DOI: <https://doi.org/10.26740/jpfa.v8n2.p91-105>.
- [5] Atasoy, S., M. Kucuk, dan A. R. Akdeniz. 2011. Remedying science student teachers' misconceptions of force and motion using worksheets based on constructivist learning theory. *Energy Education Science and Technology Part B: Social and Educational Studies*. 3(4), p. 519-534.
- [6] Jaya, S. P. S. 2012. Pengembangan modul fisika kontekstual untuk meningkatkan hasil belajar fisika peserta didik kelas X semester 2 di SMK negeri 3 Singaraja. *Jurnal Teknologi Pembelajaran*. 1(2), p. 1-24.
- [7] Johnson, E.B. 2002. Contextual Teaching and Learning: what it is and why it's here to stay. California: Corwin Press, Inc. Translate by Ibnu Setiawan. 2006. Contextual Teaching and Learning: Menjadikan Kegiatan Belajar Mengajar Mengasyikkan dan Bermakna. Bandung: MLC.
- [8] Komalasari, K. 2010. *Pembelajaran Kontekstual Konsep dan Aplikasi*. Bandung: PT Refika Aditama.
- [9] Majid, M. S. 2016. Pembelajaran fisika dengan pendekatan kontekstual melalui metode eksperimen dan demonstrasi diskusi pada materi kinematika gerak lurus. *Jurnal Teknik STTKD*. 3(2), p. 92-106.

- [10] Masril. 2012. Pengembangan model pembelajaran fisika SMA berbasis graphic organizers melalui belajar kooperatif STAD. *Jurnal Penelitian Pembelajaran Fisika*. 1(1), p. 1-9.
- [11] Mukti, A. D. Y., T. Raharjo, E. Wiyono. 2011. Identifikasi miskonsepsi dalam buku ajar fisika SMA kelas X semester gasal. *Jurnal Materi dan Pembelajaran Fisika (JMPF)*.1(1), p. 39-45.
- [12] Mursalin. 2014. Analisis penguasaan konsep mahasiswa pada topik kinematika partikel. *Jurnal Inovasi Pembelajaran Fisika (Inpafi)*. 2(2), p. 199-209.
- [13] Narjaikaew, P. 2013. Alternative conceptions of primary school teacher of science about force and motion. *Procedia-Social and Behavioral Sciences*. 88,p. 250-257.
- [14] Nurdin, B., S. Jurubahasa, dan T. Ratelit. 2013. Pemanfaatan sumber belajar berbasis contextual teaching and learning dalam upaya peningkatan kualitas pembelajaran fisika umum I. *Jurnal Pendidikan Fisika Indonesia*.9(1), p. 18-27.
- [15] Prastowo, S.H.P, B. Jatmiko dan Z.A.I. Supardi. 2017. Apposite model to improve mastery of kinematic motion concept for physics education student. *The International Journal of Social Sciences and Humanities Invention*. 4(8), p. 3703-3707.
- [16] Puspendik Balitbang Kemdikbud. 2016. Pemanfaatan Hasil Ujian Nasional 2015/2016 untuk Perbaikan Mutu Pendidikan. Jakarta: Kemdikbud.
- [17] Rodrigues, M, dan P. S. Carvalho. 2013. Teaching physics with angry birds: exproling the kinematics and dynamics of the game. *Journal Physics Education*.48(4), p. 431-437.
- [18] Sitepu, B.P. 2014. *Pengembangan Sumber Belajar*. Jakarta: PT Raja Grafindo Persada.
- [19] Sugiyono. 2009. Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Bandung: Alfabeta.
- [20] Sujanem, R., I. N. P. Suwindra, dan I. K. Tika. 2009. Pengembangan modul fisika kontekstual interaktif berbasis web untuk siswa kelas I SMA. *Jurnal Pendidikan dan Pengajaran*. 42(2), p. 97-104.
- [21] Suparno, P. 2013. Miskonsepsi & Perubahan Konsep dalam Pendidikan Fisika. Jakarta: Grasindo.
- [22] Supeno, M. Nur dan E. Susantini. 2015. Developing a textbook based on argumentation skills to facilitate students in physics instruction. *Proceeding International Conference: Trending Issues of School Education in Advanced Countries and Indonesia*. ISSN: 2443-2768.
- [23] Supeno, M. Nur dan E. Susantini. 2015. Pengembangan lembar kerja siswa untuk memfasilitasi siswa dalam belajar fisika dan berargumentasi ilmiah. *Seminar Nasional Fisika Dan Pembelajarannya 2015*. ISBN 978-602-71279-1-9.
- [24] Tebabal, A, dan G. Kahssay. 2011. The effect of student centered approach in improving students' graphical interpretation skills and conceptual understanding of kinematical motion. *Lat. Am. J. Phys. Educ*. 5(2), p. 374-381.
- [25] Wardani, I. S. 2016. Pengaruh pemahaman konsep matematika vektor mahasiswa FMIPA UNIPDU terhadap kemampuan pemecahan masalah fisika mekanika. *Jurnal Pedagogia*. 5(2), p. 215-224.
- [26] Yilmaz, I, dan N. Yalcin. 2012. The relationship of procedural and declarative knowledge of science teacher candidates in Newton's laws of motion to understanding. *American International Journal of Contemporary Research*. 2(3), p. 50-56.