



Analysis of the Concepts of Physics in Detective Conan's Animation Film

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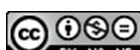
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ABSTRACT

Detective Conan is an animated film genre originating from Japan. This study aims to analyze the concept of physics in several episodes in the film Detective Conan. The concept of physics in this film is contained in the phenomena that occur in it, so it is interesting to study. The type of research method used is the type of descriptive method. The research uses a form of direct observation methods, namely watching animated episodes as well as data collection, literature studies and analysis of physics concepts to describe existing phenomena. Based on the results and discussion, it can be concluded that Detective Conan is a Japanese animated action genre film with the concept of the main character acting as a detective and is required to be able to solve all crime cases and puzzles so that they can be solved. Some of the physics concepts found in several episodes of Detective Conan are about Archimedes' law, Boyle's law, about temperature, perfect internal reflection, uniformly changing rectilinear motion and uniformly rectilinear motion, tyndall effect, electricity, dynamic electricity and up to parabolic motion. The study of the film Detective Conan is expected to be able to increase students' interest and abilities in learning physics. regarding temperature, perfect internal reflection, uniformly changing rectilinear motion and uniformly rectilinear motion, the Tyndall effect, electricity, dynamic electricity and up to parabolic motion.

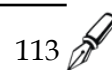


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INTRODUCTION

In the era of rapid technological advances, the development of information media is increasingly widespread without being limited. It is undeniable that in the current era there are many things that can be accessed, one of which is in the form of animated films which can be seen and watched by various groups ranging from children, adolescents and adults freely and legally (Torabian, & Tajadini, 2017). Surely many already know about Japanese animated films, namely anime. In addition to knowing the storyline of the film, animated films are also audio-visual media which are packaged in an attractive way, which can be in the form of a collection of scenes and good quality audio so that the moral message conveyed is easily accepted (Astuti et al., 2019; Munir et al., 2016), besides that we can also analyze theoretical physics by watching anime which of course can increase curiosity and enthusiasm for learning (Ozer & Avcı, 2015). Anime is basically man-made and computer animation originating from Japan.

Physics can be something that is not boring if it is packaged in an interesting medium, namely with an explanation contained in an anime. Outside Japan and in English, anime refers specifically to animation produced in Japan. Physics can be analyzed through anime and not only through anime, it can be done in other forms such as cartoons or movies (Ryu et al., 2020). For example, in the Detective Conan anime series, Dr. Stone, Steins Gate etc. anime refers specifically to animation produced in Japan. Physics can be analyzed through anime and not only through



anime, it can be done in other forms such as cartoons or movies. For example, in the Detective Conan anime series, Dr. Stone, Steins Gate etc. anime refers specifically to animation produced in Japan. Physics can be analyzed through anime and not only through anime, it can be done in other forms such as cartoons or movies (Agustin et al., 2017). For example, in the Detective Conan anime series, Dr. Stone, Steins Gate etc.

Characters from animated cartoons can have a very important role in being able to introduce various disciplines and knowledge and can provide a very broad educational understanding. Japan is the country where the animated film industry was born, which continues to grow today, where Japan promotes anime cartoons to the world market and makes anime known and in demand among children, adolescents and even adults. One way for Japan to introduce anime is by promoting it through the Cool Japan Strategy which is overseen by the Ministry of Economy, Trade and Industry (deWinter, 2017; Daliot-Bul & Otmazgin, 2020). Japan is the country that produces the most animation and even has fans almost all over the world (Daliot-Bul & Otmazgin, 2020). Animation can be a means of learning media and is still being developed today and there are many animated models for learning media (Agustin et al., 2017; Nordin & Osman, 2018). The use of animation as a supporting medium for classroom learning has been implemented in Japan since the late 1980s and early 1990.

Education regulations in Indonesia analyze the rules regarding education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, as well as the skills needed by himself, society, nation and state. Education is very important for students to have, even education at this time can be obtained at school or outside of school and inside school (Wulandari & Ermawati, 2019). One of the branches of Natural Sciences (IPA) is physics which is a science that studies natural phenomena. Physics is the basis of science, which is knowledge that is obtained based on observation and experimentation, and connects reality based on scientific methods so that its existence is very important for the development of science and technology. Physics can be taught in various ways with concepts that can be taught with phenomena or media found in everyday life. The purpose of this writing is to analyze the physics concepts contained in animated cartoons and how they are explained according to the physics theory.

RESEARCH METHOD

This research uses a type of qualitative descriptive research method. Descriptive research method is a research characteristic that specifically reveals various social and natural phenomena that exist in people's lives. Taylor et al (2015) stated a qualitative approach is a research procedure that produces descriptive data in the form of written or spoken words from several people and observed behavior (Taylor et al., 2015). This research was conducted using the direct observation method, namely watching several animated episodes at the same time as a data collection step, literature study and analysis of physics concepts to describe existing phenomena.



Figure 1. Research methods

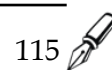


RESULTS AND DISCUSSION

In this study, we will discuss some of the physics concepts contained in the animated film Detective Conan, both from the series and the movie. Based on several series and movie references, we are very interested and found several interesting concepts and are used to solve a problem including:

Table 1. Concept of physics in film Detective Conan

No	Picture	Episode	Physics Concept
1	Source: nontonanimeid.fun	745	Boyle's law: states that volume is proportional to pressure.
2	Source: nontonanimeid.fun	756	Archimedes' law: states that the upward lifting force on an object if it is put into a fluid (liquid or gas).
3	Source: nontonanimeid.fun	706	Temperature. Nucleation is the process of forming a stage in thermodynamics.
4		788	Total Internal reflection states that a ray of light does not penetrate, but reflects at the boundary between water and air.



			
	Source: nontonanimeid.fun		
5		862	ASM (Alternate Straight Motion)
	Source: nontonanimeid.fun		
6		1054	The Tyndall effect states that a beam of light will be scattered in all directions due to the presence of small particles of the medium through which the light passes.
			
	Source: nontonanimeid.fun		
7		1078	Electricity and Dynamic Electricity: The electric current flowing from the battery from the positive to the negative pole is flowing through the foil with a large number of electrons, then the foil can burn.
			
	Source: nontonanimeid.fun		
8		Movie 1 : The Time-Bombed Skyscraper	Uniform Straight Motion: A train that moves straight with a minimum speed of 60 km/hour and one 20m long carriage, totaling 10 cars with a target train must be able to pass 200 meters under a 13 second delay.



Source: koenime.net

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$$t = \sqrt{\frac{2 \times 20}{9.80665}} = 2.02$$

t = 時間 (秒)
 g = 重力加速度 9.80665 m/sec^2
 s = 落下距離 20 m
 Jika kau masukkan dalam persamaan ini, hasilnya jadi 2.02

$$\begin{aligned}
 2 \text{ 秒} &\rightarrow 60 \text{ m} \\
 1 \text{ 秒} &\rightarrow 30 \text{ m} \\
 30 \text{ m/sec} &\rightarrow 108 \text{ km/h}
 \end{aligned}$$

Source: koenime.net

Movie 5 :
Countdown to
Heaven

Parabolic Motion: A car that is being ridden is targeted to be able to get from one building to another lower building without having or there is a possibility of falling to the ground because the height of the building is very high and in this incident because the speed of the car is felt to be lacking, it relies on the help of the resulting air power from the explosion of a bomb attached to the building

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Source: koenime.net

Some Episodes
and Movies

Work and Energy and the Law of Conservation of Energy as well as Friction: In principle it works that the skateboard is designed to obtain energy from solar or solar energy which is converted into electrical energy and then stored with a battery and then this power is used to drive the engine so that it can be used to chase enemies or used for driving

Based on the data Table 1, Table 1 in number 1, episode 745 of Detective Conan, Boyle's law states that volume is proportional to pressure. In this episode, where there is a phenomenon where a candle is placed in a container filled with water, then the candle is turned on, then the candle is covered with a clear glass, causing the candle flame to go out. This phenomenon occurs because when the candle flame goes out, the water under the candle rises up. Furthermore, when the candle is covered with glass, the oxygen around it becomes non-existent. Oxygen is important in the combustion process which can maintain the flame. If there is no oxygen, the flame will die / go out. This causes the water that is under the candle to be sucked up until the candle flame

goes out because it runs out of oxygen. This process occurs because oxygen molecules will disappear and cause the air pressure inside the glass to be smaller than the air pressure outside the glass. This displacement process applies Boyle's law.

In number 2, episode 756 of Detective Conan, Archimedes' Law states that an upward force occurs on an object if it is placed in a fluid, namely liquid or gas. The phenomenon that occurs is that at first the tomatoes sink, then when added with a sprinkling of salt causes the tomatoes to float. This is because salt has a higher density than water, so it can make the tomatoes that were initially sinking float to the surface of the water. So that in this case a physical phenomenon occurs in the form of Archimedes' law, namely the Buoyancy Force. Buoyancy is an upward lift force that is opposite to the weight of the object immersed in the fluid. The upward force occurs due to the difference in the density of the liquid with the density of the object. When added salt to water causes the mass of water to be higher. So that the density of objects becomes smaller than the density of water added with salt, then the tomatoes that were previously submerged in water when sprinkled with salt into it cause the tomatoes to float. This process is due to Archimedes' Law. This shows that through anime videos can add insight into physics to students (Astuti et al., 2019).

In number 3, episode 706 of Detective Conan, the concept of temperature physics. The phenomenon that occurs is that at first putting a bottle filled with water into a freezer or refrigerator until the drink gets cold but does not freeze, then put the key into the bottle containing the cold water. Then, the drink that contains the key when it is pounded, the drink becomes frozen. So this is called a phenomenon called supercooling water. Where, when water is put in the freezer the water is cooled to below its freezing point temperature. But not until the freezing process occurs. To become an ice, the drink needs to be triggered as it is pounded so that the water in the bottle will freeze. The process in which water immediately freezes occurs due to the temperature of the liquid in the very cold bottle reaching below the freezing point. The ice that is in the liquid that is in the bottle forms ice cubes. This ice cube is water that has lost heat energy resulting in the formation of solid ice crystals. So that when the water in the bottle freezes, heat energy is released from the water into ice cubes. The result of the release of this heat energy will make the water molecules that were initially loose become solid. This occurs a process called nucleation. Nucleation is the pushing of molecules in the liquid to form ice crystals. When the liquid in the bottle is removed from the freezer, a nucleation process is taking place, in which the water is very cold but not yet frozen. This impact causes the very cold-water molecules to collide with each other tightly, then creates these molecules into ice crystals. Therefore, the water in the bottle which has a very cold temperature will turn into ice crystals. The result of the release of this heat energy will make the water molecules that were initially loose become solid. This occurs a process called nucleation. Analyzing natural phenomena while watching videos is very important, and able to attract interest in learning (Ryu et al., 2020).

In number 4, episode 788 of Detective Conan, the concept of physics, namely the occurrence of Total Internal Reflection (Perfect Internal Reflection) states that light does not penetrate, but reflects on the border between water and air. The phenomenon that occurs is that something is placed in the water, namely coins covered in clear glass with room for air, causing the coins to become invisible. This happens because of the refraction of light. When light moves from air to water, it will experience refraction, which is a change in the direction of light due to the difference in density of the two media. Conversely, when light moves from water to air it will experience refraction which causes when it is in air the light will be deflected at a larger angle. The light from the water with a wider angle will later reach a point where the refraction becomes very large, then the light will reflect. As a result, when you look at it from a wide angle, the light will reflect and you won't see the object in it, but you can see the reflection that is happening in front of it. To see the coins in the glass, reduce the viewing angle so that later you can see the coins in it.

In number 5, episode 862 of Detective Conan, the concept of Physics, namely ACSM (Alternatively Changed Straight Motion). The phenomenon that occurs is that when a ball filled



with honey is rolled on an inclined plane, the ball will go down the inclined plane more slowly. This happens because the movement of the ball is inhibited by the honey in it, so the ball moves slower. The physics concept related to this phenomenon is ASM or Alternating Straight Motion. ASM (Alternate Straight Motion) is the movement of an object across a straight path with a constant acceleration. The main feature of this ASM is that at certain times the speed of objects can be accelerated or decelerated. In the phenomenon of a ball containing honey, the ball's speed will slow down. If the ball is not covered with honey, the ball will experience a speed that is getting faster and faster. When there is something in the ball, namely honey, the speed of the ball will slow down. This can be called a slowed ASM, where the acceleration of the ball decreases regularly and will experience a constant deceleration.

In number 6, episode 1054 to be exact, Detective Conan has a related physics concept, namely the Tyndall Effect which states that light beams are scattered in various directions due to the presence of small particles in the medium through which light passes. The phenomenon that occurs is a mixture of water and milk placed in front of the flashlight which is little liquid becomes bright. This happens because there is a physics concept, namely the Tyndall Effect. The Tyndall effect is a phenomenon that occurs due to the scattering of light rays from colloidal particles. In this phenomenon, light can penetrate clear objects, so that when the liquid milk in the bottle is placed in front of the flashlight that is on, the flashlight will penetrate the clear bottle through the gap in it. This process causes the flashlight to be brighter than before.

In number 7, episode 1078 to be exact, Detective Conan has a physics concept, which is related to electricity and dynamic electricity where in that incident when we are in nature and only have a battery and foil, the battery is designed so that current flows from the negative pole to the positive pole, in the above phenomenon, foil is used as a liaison between the positive and negative poles of the battery so that electric current can flow, but the foil will certainly receive a very large current so that large currents generate heat because the foil is not protected with an insulator, plus if between foils, if cut in part in the middle, the current will gather in the small central part, then because it is concentrated in that part, the heat generated is greater and is able to produce fire to be used as an emergency lighter, this phenomenon is the same as a short circuit that occurs in certain events where in we make it appear as if the battery is shorted. This phenomenon is the same as a short circuit that occurs in certain events where in this case we make it appear as if the battery is shorted.

In number 8, precisely in Detective Conan movie 1: *The Time-Bombed Skyscraper*, there is a physics concept, namely in the form of uniform straight motion where there is an incident when a bombing case will occur at a railroad crossing, but the bomb uses a sensor in the form of light where the train does not may move or pass at a speed of less than 60 km/hour or around 16.7 m/s. At the same time it is estimated that 1 train car has a length of 20 meters and for one departure the train carries 10 cars, meaning the length of the train is about 200 meters, meaning that at a speed of 60 km/hour, the train has about 12 seconds to arrive at a distance of 200 meters, we can use the equation

$$s = v \cdot t \quad (1)$$

Where s is the distance that must be traveled by the train, namely until the carriages run out, which is 200 meters and v is the speed of the train, which is around 60 km/hour or 16.7 m/s, then the travel time of the train sought for the train is estimated until then the equation changes to

$$t = \frac{s}{v} = \frac{200 \text{ meter}}{16,7 \text{ meter/second}} = 11.97 \text{ second} = 12 \text{ second} \quad (2)$$

So it was found that to reach a distance of 200 m the train has 12 seconds to arrive at a speed value of 16.7 m/s. another thing to note is that in this incident the bomb that was installed had a light sensor where the time would run when it was not exposed to sunlight and the bomb's travel time for the explosion to occur was about 13 seconds so there was still 1 second left before the bomb was expected to explode and would repeating the countdown time again as a result of



which all the trains were directed to change lanes and move no less than 60 km/hour and in the end the bomb did not explode and everyone survived.

In number 9, precisely in Detective Conan movie 5: *Countdown to Heaven*, there is a physics concept, namely Parabolic Motion where at that incident there was also a bombing case in a twin building, one of which was lower, in this phenomenon Conan and friends were trapped in a taller building, high to be precise on the 75th floor or the top floor. but they only have one thing to survive and that is to use the car to get to a lower building without falling to the street or ground floor. By estimating that the building that is currently located is on the 75th floor then the second building with the 69th floor has a height difference of about 20 meters and the distance between buildings is 60 meters plus the presence of gravitational forces, of course, even though objects move horizontally, of course when they are in the air, they will fall due to gravitational forces. In this case, we take the equation

$$t = \sqrt{\frac{2s}{g}} \quad (1)$$

Where s is the distance that must be traveled by the car to get to the next building which is 20 meters and g is the value of the acceleration due to gravity of 10 m/s² then the travel time of the train sought for the car is estimated until then the equation changes to

$$t = \sqrt{\frac{2 \times 20}{10}} = \sqrt{\frac{40}{10}} = \sqrt{4} = 2 \text{ s} \quad (2)$$

It was found that with a building height difference of 20 meters, it takes 2 seconds to fall and reach another building, but on the other hand the distance between buildings is 60 meters, so it takes at least 1 second to reach a distance of 30 meters and 2 seconds for 60 meters. In this case the car must have a speed of 30 m/s or around 108 km/hour then the odd thing is that a car cannot move at that speed especially in an enclosed space with a small scope, therefore in this case they can only getting a speed of 50 or 60 km/hour so they thought to go hand in hand with the explosion of the bomb so that the bomb gave a gust or wind pressure so that the car was pushed along and arrived at another building safely and finally conan and his friends survived.

In figure 10, to be precise, in several episodes and films from Detective Conan, there is a physics concept that is applied, namely one of the tools he often uses, namely a solar-powered skateboard, which is used to drive or chase criminals. But what you need to know about this tool is that it uses solar power to be able to walk freely and not move freely at night. Here the working system of the tool is that solar power from the sun is received by the solar panels above the skateboard, then this energy is converted into electrical energy and stored in a special battery that has a resistance of up to 30 minutes until the skateboard stops moving which can be used at night. then the electrical energy is channeled to an engine generator so that the skateboard can move. In its use there are important components including a suspension that functions like a shockbreaker to dampen vibrations, this is in accordance with frictional forces as well. From some of the explanations above, it can be seen that learning can be created through film stories, animated films are also audio-visual media that are packaged in an interesting way, can be in the form of a collection of scenes and good audio quality so that the moral message conveyed is easily accepted. (Astuti et al., 2019; Munir et al., 2016).

CONCLUSION

Detective conan is a Japanese animated action genre film with the concept of the main character acting as a detective and is required to be able to solve all crime cases and puzzles so that the mystery behind them can be solved. Some of the episodes that have been released cannot all be analyzed by the concept of physics, however, based on the results and data that have been presented above, there are several snippets of them, both in the form of concepts with equations and only explanations, including about Archimedes' law, Boyle's law, about temperature, perfect internal reflection, uniformly changing rectilinear motion and uniformly rectilinear motion, tyndall effect, electricity, dynamic electricity and up to parabolic motion. Enjoying and learning from the film Detective Conan is also part of edutainment learning that can be applied to students



in the sense that besides enjoying the events in the film we can also learn how a phenomenon can be solved with physics concepts. So that learning with this concept can be applied and it is hoped that in future research it can find other physics concepts that have not yet been found in the Detective Conan film.

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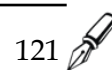
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