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ELECTRONIC SKATE POWERBANK

[1]DR. DENNIS OSORO MARANGA, [2]JOAN NDEMO, [3]IDDAH OKOTH, [4]CALVINS ORUKO, [5]SHAZ BASWETI OSORO

[1]PhD (Finance), Department of Accounting and Finance, Kenyatta University, Kenya
[1]MBA (Finance), CPA (K), Bed Science (IT), Director Shareholder, Qaribu Discount Limited, Kenya,
[1]Patron-Science Club, St Angela Sengera Girls High School, Kenya,
[2,3]Student-Science Club, St Angela Sengera Girls High School, Kenya,
[4]Patron-Science Club, Kisumu Senior Academy, Kenya,
[5]Student-Science Club, Excel Elementary School, Kenya.

ABSTRACT

Environmental protection and energy conservations are the main concern of the 21st century which has now accelerated the pace to plan and develop energy conservation technology. Previous endeavors to conserve energy has been retarded by minimal innovation among young scientists. The existing sources of energy have become a menace to society. Most of them are pollutants and therefore the need to come up with an alternative source of energy that reduces global warming. This is reflected in skating where the energy used by skaters has not been harnessed. Innovation is one of vision 2030 social and economic pillars. However, studies that have been conducted previously indicate that practicing prudent conservation of energy can lead to minimized expenses among human beings. However, these studies did not construct a device that can aid in conservation of energy among people engaging in skating. Therefore this study sought to construct and evaluate an electronic skate power that will be able to convert kinetic energy produced during motion to chemical energy. The specific objectives of this study were to; investigate the relationship between distance covered and amount of energy generated; determine if the speed of movement affects the amount of energy generated by the skate; determine if the electronic skate power is capable of converting kinetic energy to chemical energy; determine the efficiency of the skate power in converting kinetic energy to chemical energy.. Experimental data was collected from Omoringamu-Sengera tarmac road, in Gucha town, Kisii County, Kenya. This study analyzed data using tabular and graphical analysis. The study therefore concluded that, as the distance covered increased, the more the charge that was recorded on the power bank. It was also noted that the faster we moved over the same distance, the more the charge that was recorded on the power bank. The study also found that the electronic skate power is capable of converting kinetic energy to chemical energy and also more efficient than a regular skate in converting kinetic energy to chemical energy. This study recommends that the Electronic Skate power Bank be implemented as one of the modes of transport in order to minimize foreign consumption of energy. This study recommends that since skating is an exercise and can help improve health and hence minimize lifestyle diseases in the developing countries, the Electronic Skate power Bank should be sensitized among many travelers hence a solution to "Health", which is a key pillar of the Big 4 agenda of the government of Kenya. In future, this study plans to convert and use the energy stored in the power bank during skating in powering the skateboard when the person becomes tired in skating manually and hence the skater can enjoy an automated skating therefore achieving Newton's Law of motion which states that energy is neither created nor destroyed but is converted from one form to another. With the adaptation and implementation of the electronic skate power bank as one of the modes of transport, pollution will be significantly minimized.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Around 93% of today's automobiles run on petroleum based product, which are estimated to be depleted by the year 2050 (Agus, Jimmy & Nana, 2013). The first law of conservation of energy states that energy cannot be destroyed nor created but can only be transformed from one form to another (Darshil, Jaydip & Patel, 2014). Energy can therefore be conserved and re-used in various purposes. Energy can be converted from one form to another which involve the use of a transducer which is irresponsible for the work of transformation (Zhidong, 2011).

Fig 1.1 Conversion of Energy

According to Bruce and Butcher (2012), EVs have been vehicles of numerous advantages: The problem of environmental pollution can be avoided to a certain extent. This therefore encourages the method of sustainable development that has been the topic of concern in the modern society. Moreover, EVs mode of operation are maximum efficient to the conditions in that at low speed and high traffic areas where gasoline engine is least efficient with a lot of energy wasted, EV moves with power from battery. At up slopes where high power is required to skate the board hence electric power is used for vehicle motion to achieve the top easily. Thus the advantages of EV make it superior than any other vehicle of today (Darshil, Jaydip & Patel, 2014).

According to Nicolo, Sivakumar and John (2017), environmental protection and energy conservations are the main concern of the 21st century which has now accelerated the pace to plan and develop energy conservation technology. Electric vehicles (EVs) offer a zero emission, new automobile industry establishment, and economic development, efficient and smart transportation system.

1.1 Statement of the problem

Environmental protection and energy conservations are the main concern of the 21st century which has now accelerated the pace to plan and develop energy conservation technology. Previous endeavors to conserve energy has been retarded by minimal innovation among young scientists. This is reflected in skating where the energy used by skaters has not been harnessed. The existing sources of energy have become a menace to society. Most of them are pollutants and therefore the need to come up with an alternative source of energy that reduces global warming.

Fig 1.2 Pollution by existing sources of energy

Innovation is one of vision 2030 social and economic pillars. However, studies that have been conducted previously indicate that practicing prudent conservation of energy can lead to minimized expenses among human beings. However, these studies did not construct a device that can aid in conservation of energy among people engaging in skating. Therefore this study sought to construct and evaluate an electronic skate power that will be able to convert kinetic energy produced during motion to chemical energy. The current study constructed and evaluated an electronic skate board with a USB port that was used in harnessing kinetic energy to chemical energy which could be used for powering devices with USB ports such as phones.

1.2 Objectives of the study

1.3.1 General Objective of the study

- To construct and evaluate an electronic skate power that will be able to convert kinetic energy produced during motion to chemical energy.

1.3.2 Specific Objectives of the study

- To investigate the relationship between distance covered and amount of energy generated.
- To determine if the speed of movement affects the amount of energy generated by the skate.
- To determine if the electronic skate power is capable of converting kinetic energy to chemical energy.
- To determine the efficiency of the skate power in converting kinetic energy to chemical energy.

1.3 Research question

- Does the distance covered affect the amount of energy generated during skating?
- Does the speed of movement affect the amount of energy generated during skating?
- Is the electronic skate power is capable of converting kinetic energy to chemical energy?
- What is the efficiency of the skate power in converting kinetic energy to chemical energy?

1.4 Research hypothesis

- Energy produced during skating depends on the distance covered during skating.
- Energy produced during skating depends on the speed of movement during skating.
- The electronic skate power is capable of converting kinetic energy to chemical energy?
- An electronic skate power is more efficient than a regular skate in converting kinetic energy to chemical energy.

1.6 Variables of the study

Dependent Variable

- Charge increment in percentage
- The Average pace in kilometers per hour
- Kinetic energy converted to chemical energy
- Efficiency of energy conversion

The independent variable

- Distance covered
- Student identifier
- Type of skate power

1.7 Organization of the study

The study is divided into five chapters. Chapter one brings out the introduction to this study. This chapter will include the background of the study, the statement of the problem, the research objectives, the hypothesis, the significance, the scope and the limitations of the study. Chapter two will entail the Literature review of the study. Chapter three of the study will have the research methodology of this study. Chapter 4 will include the Data analysis and discussion while chapter 5 will entail the conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter is divided into four parts which include the introduction, the empirical literature review, a summary of the empirical literature review and Energy storage options. A critical review of previous literature contributions by other scholars is also presented through the empirical literature review for the research gaps to be unfolded, hence providing a knowledge gap for the current study.

2.2 Empirical Literature Review

Nicolo *et al.,* (2017) investigated a hybrid bicycle that was used to power an electric hub motor running a bicycle. In this electric hybrid bicycle, the front wheel had a compact & light weight hub motor. It was having a regenerative charge system and solar panels, which enabled substantially longer distance power assist cycling by regenerating power from pedaling energy (human energy) and solar energy and charging it in the battery. This knowledge was previously not applied on the skateboard. The current study constructed and evaluated an electronic skate board with a USB port that was used in harnessing kinetic energy to chemical energy which could be used for powering devices with USB ports such as phones.

Darshil *et al.,* (2014) investigated the construction of an electronic skate power that was expensive. Two fundamental components in the electric skateboard were the electric motor and its energy storage system. The motor used in this electric car was a brushless dc (BLDC) motor type. A controller was used to convert the dc source into ac for BLDC motor power source. This electrical energy storage affected performance of the electric car. Therefore the battery had to be protected from anything that could make the battery's life shorter. Voltage was one of the parameters that had to be controlled by the battery management system, so that the battery can be protected effectively. The current study investigated an electronic skate shoe that was cheaper in the initial and the maintenance costs.

2.3 *Energy storage option*

Zhidong (2011) asserts that a wide array of different types of energy storage options are available for use in the energy sector and more are emerging as the technology becomes a key component in the energy systems of the future worldwide. As the need for energy storage in the sector grows, so too does the range of solutions available as the demands become more specific and innovations drawing on state-of-the-art materials and technologies are developed.

J. Bian, et. al, (1997) explains that while the need is not new – people have been looking for ways to store energy that is produced at peak times for use at a later moment to reduce imbalances between energy demand and energy production – energy storage is now booming in the sector. Applications are becoming more diverse and widespread geographically with the growth of variable wind and solar energies, decentralization of the power system and the need for resilience in the network.

Darshil, G., Jaydip, C. & Patel, R. (2014) assert that the output of wind and solar dependent on the local weather, variability can occur on short timescales or the times of generation may not correspond to that of the demand. For example, in the case of solar, the maximum output is normally in the middle hours of the day but the biggest demand peak is often in the evening. The growth of rooftop PV and electric vehicles are another challenge leading to bidirectional power flows in the grid and the need to avoid local congestion, if for example, multiple EVs are plugged in for recharging at the same time. In this case, energy storage can support the deferral of investment in grid reinforcement.

Thus a range of solutions is needed (Kolluri, 2002). Energy storage systems can range from fast responsive options for near real-time and daily management of the networks to longer duration options for the unpredictable week-to-week variations and more predictable seasonal variations in supply and demand. Key use cases include services such as power quality management and load balancing as well as backup power for outage management.

The different types of energy storage according to Nicolo, D., Sivakumar. H., & John W., (2017) can be grouped into five broad technology categories:

- Batteries
- Thermal

- Mechanical
- Pumped hydro
- Hydrogen

Within these they can be broken down further in application scale to utility-scale or the bulk system, customer-sited and residential. In addition, with the electrification of transport, there is a further mobile application category.

2.3.1 Battery storage

Batteries, the oldest, most common and widely accessible form of storage, are an electrochemical technology comprised of one or more cells with a positive terminal named a cathode and negative terminal or anode (Han, Karady, Park and Moon, 1998). Batteries encompass a range of chemistries. The best known and in widespread use in portable electronic devices and vehicles are lithium-ion and lead acid. Others solid battery types are nickel-cadmium and sodium-sulphur, while zinc-air is emerging. This study therefore sought to use a power bank battery to store the power converted from kinetic energy to mechanical energy.

CHAPTER THREE

METHODOLOGY

3.1 Requirements

i. Skate board wheel
ii. Connecting wires
iii. Dynamo
iv. LED bulb
v. USB hub
vi. Power bank
vii. Easy count Energy meters (for measuring amount of energy)

3.2 Procedure

i. Remove the wearable part of the skateboard.
ii. Check if wheels are aligned correctly.
iii. Identify the wheel with the roughest texture.
iv. Try rubbing the dynamo to establish connection.
v. Check for voltage out from the dynamo by confirming if the LED bulb lights.
vi. Connect the lamps and the power bank.

Fig 3.1 Electronic Skate power bank

3.3 Block diagram

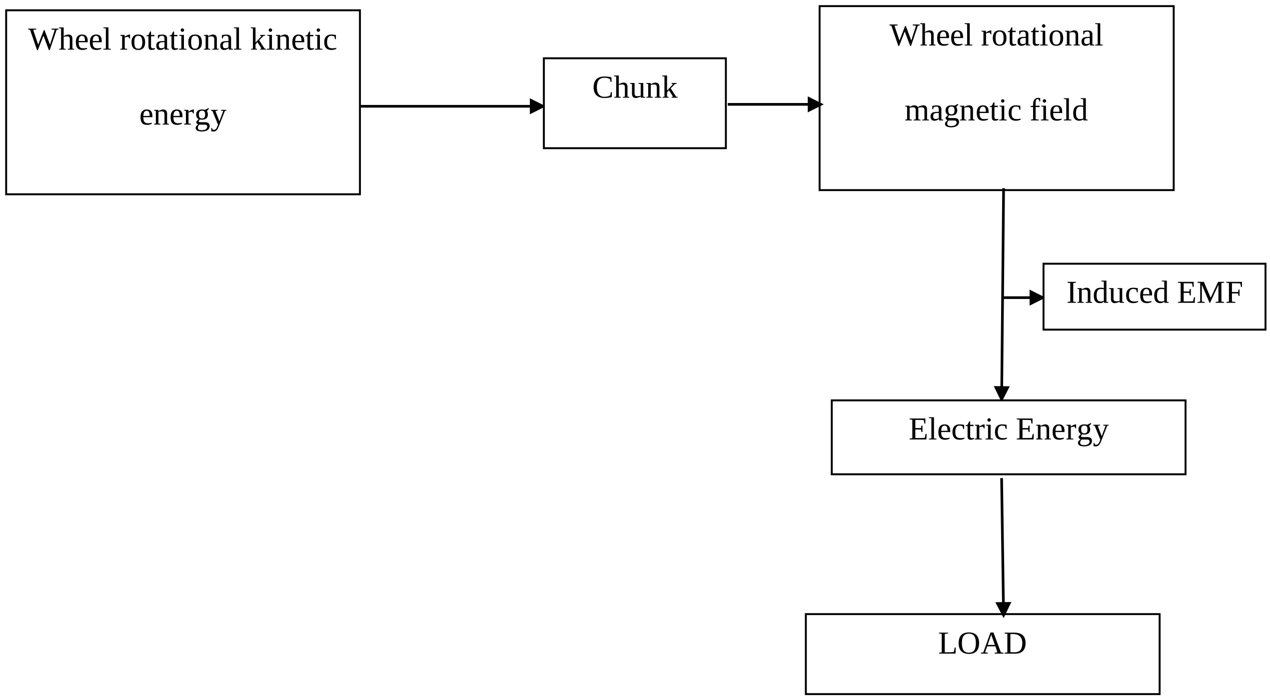

Fig 3.2 Block diagram

3.4 Observation

When the skateboard is on motion the wheels of the skate exert pressure against the dynamo, making the dynamo to rotate. Rotational kinetic energy from the wheels is able to create a rotating magnetic field within the windings in the dynamo. This induces an EMF on the battery hence producing electric energy which lights the bulb. This energy is stored in the power bank as chemical energy and can be used in powering devices that use USB cable such as a phone.

3.5 Significance of the study

The government stands to benefit a lot from this study in regards to means of transport. It could be able to consider an incorporation of findings obtained from this study to enable people with a low income to have a cheaper means of transport and hence improve the economy of the country. Investors will also be in a good position to invest in this means of transport. The results and recommendations from this study will be an eye opener to various researchers to venture into more modes of road transport that can minimize pollution.

3.6 Limitations of the study

- This study experienced energy losses during conversion of energy. However, this study addressed this problem by using a capacitor to minimize sparks produced which lead to energy losses.

- Low amounts of charge are generated over shorter distances and smaller speeds. The experiment was conducted over relatively longer distances and relatively faster speeds.

3.7 Precautions of the study

- Be careful when skating. The skater needs to wear a helmet and protective clothing to avoid serious injuries in case of an accident.
- Just like a motor vehicle, skaters need to undergo intense training before skating.

CHAPTER FOUR

DATA AND DATA DISCUSSION

4.1 Data collection

The data below shows an average increment of charge level as recorded by the power bank across three categories of distances covered. The power bank we earlier used shows different charge percentages when switched on and belonged to our principal who we had acknowledged earlier on. The results are as shown below.

4.2 Data analysis

In Table 4.1 and Fig 4.1 below, the dependent variable is the charge increment in percentage. The independent variable is the Average Distance covered (km). Note that the three categories of distances covered is what leads to variations in charge increment. The study therefore **concluded that, as the distance covered increased, the more the charge that was recorded on the power bank.**

The table and graph below give a better visual representation.

Table 4.1 Charge increment in percentage versus Average distance covered

Average Distance covered (km)	Charge increment in percentage
5	25
10	50
15	75

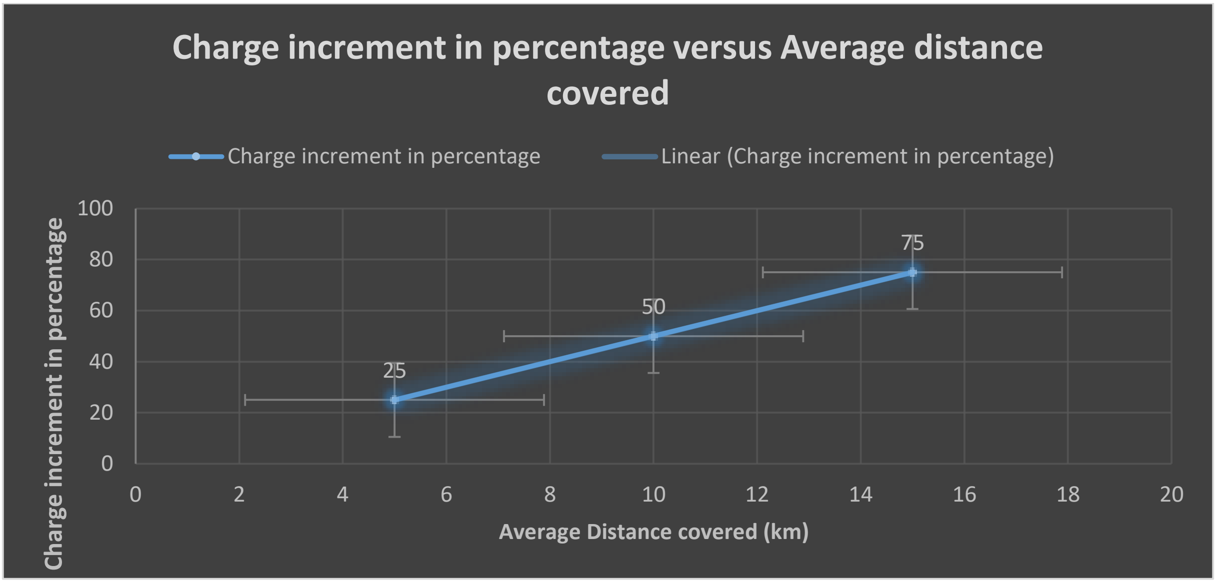

Fig 4.1 **Charge increment in percentage versus Average distance covered**

In Table 4.2 and Fig 4.2 below, the dependent variable is both the average pace and the increment in percentage. Student C was female and anatomically could not keep up with the male. We do not mean ladies are weaker, this could also just be a coincidence. The independent variable is the student identifier. Note that the student identifier is what leads to variations in pace and charge increment.

The study also concluded that the faster we moved over the same distance, the more the charge that was recorded on the power bank.

The table and graph below give a better visual representation.

Table 4.2 Average pace in kilometers per hour/ Charge increment in percentage

Student identifier letter	Average pace in kilometers per hour (speed = distance / time)	Charge increment in percentage
A	11	26
B	15	32
C	8	17

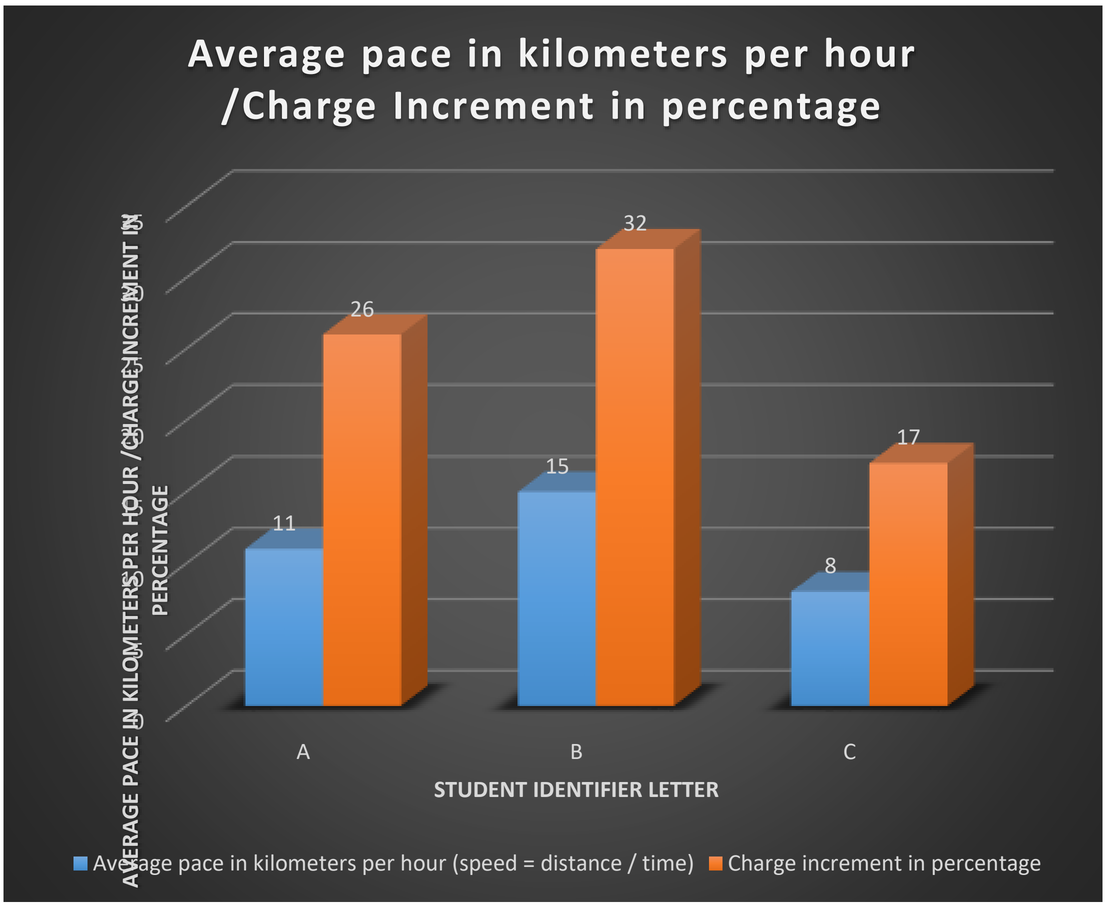

Fig 4.2 Average pace in kilometers per hour/Charge increment in percentage

In Table 4.3 and Fig 4.3 below, the dependent variable is the ***Energy (Joules/kg) of the skate power***. The independent variable is the Type of skate power. From the results obtained in Table 4.3 and Fig 4.3, the Kinetic energy converted to chemical energy during forward skating for the Electronic Skate power is 1300 Joules/kg while the Kinetic energy converted to chemical energy during forward skating for the Regular Skate is 0 Joules/kg. These values were measured using the Easy count Energy meters. The Kinetic energy converted to chemical energy during forward skating for the regular Skate power is 0 Joules/kg because it does not have a mechanism (dynamo) for converting kinetic energy to chemical energy. **This therefore implies the electronic skate power is capable of converting kinetic energy to chemical energy.**

The table and graph below give a better visual representation.

Electronic Skate power Energy (Joules/kg)	**Regular Skate Energy (Joules/kg)**
1300	0

Table 4.3 Energy (Joules/kg) versus Type of Skate power

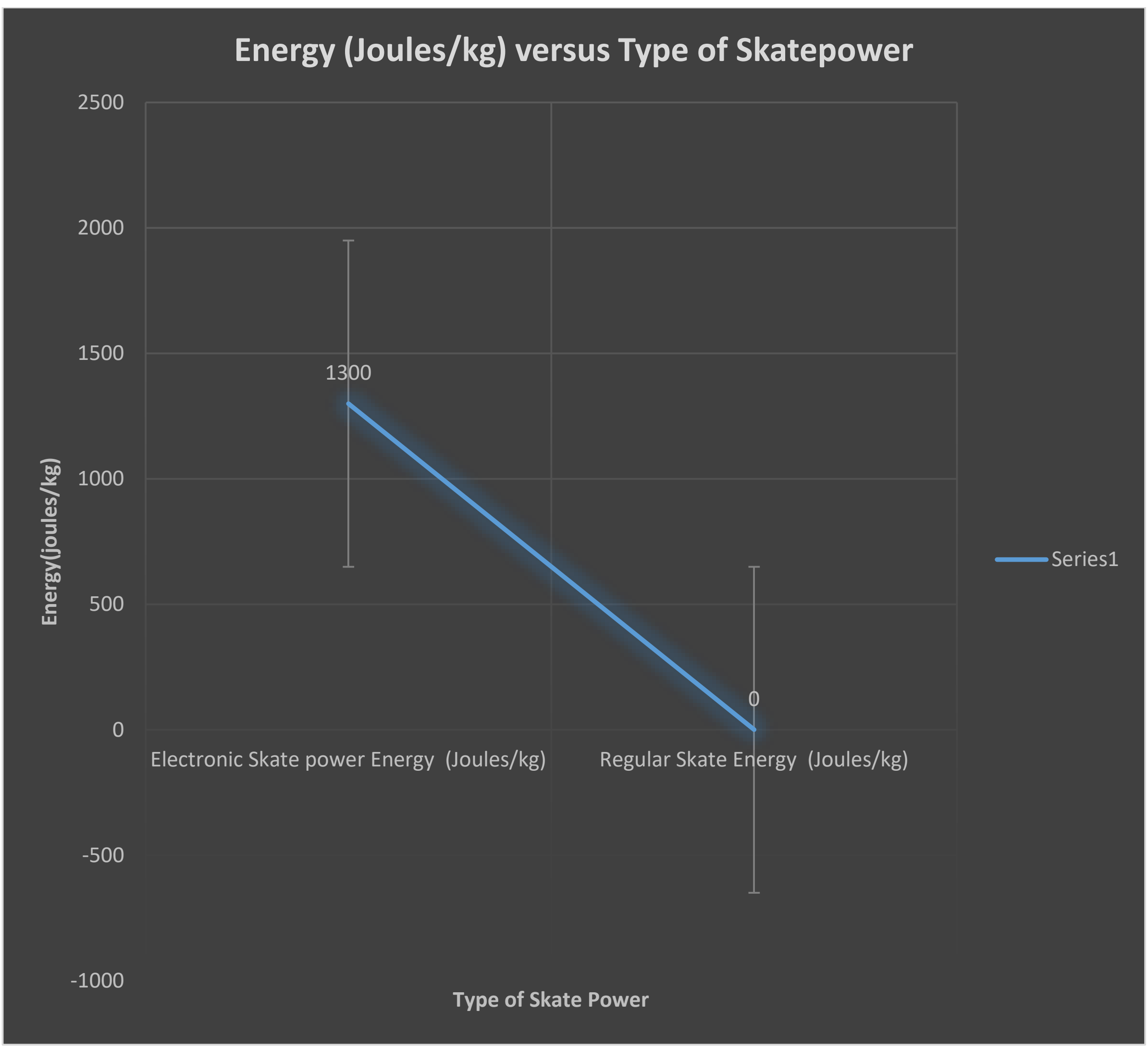

Fig 4.3 Energy (Joules/kg) versus Type of Skate power

From the results obtained in Table 4.4 and Fig 4.4 below, the dependent variable is the ***Efficiency of skate power in converting Kinetic energy to chemical power***. The independent variable is the Type of skate power. The Efficiency of the skate power in converting kinetic energy to chemical energy during forward skating for the Electronic Skate power is 87.54 % while the Efficiency of the skate power in converting kinetic energy to chemical energy during forward skating for the regular skate is 0 % since no energy was converted to chemical energy. These values indicate that the electronic skate power is 87.54 percent more efficient in energy conversion than the Regular skate in the energy produced as measured by the Easy count Energy meter. This is because the Regular skate does not have a mechanism (dynamo) for converting kinetic energy to chemical energy. **This therefore implies the electronic skate power is more efficient than a regular skate in converting kinetic energy to chemical energy.**

Electronic Skate power Energy (%)	Regular Skate Energy (%)
87.54	0

Table 4.4 Efficiency of the skate power in converting kinetic energy to chemical energy during forward skating.

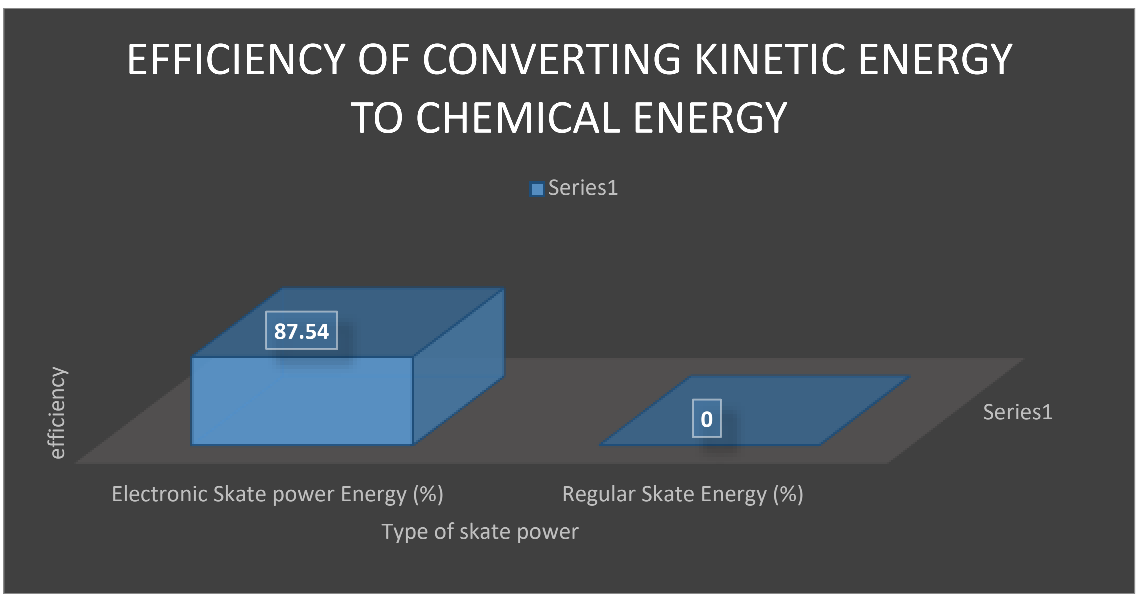

Fig 4.4 Efficiency of the skate power in converting kinetic energy to chemical energy during forward skating.

4.3 Data Discussion

From the results obtained in Table 4.1 and Fig 4.1 below, the dependent variable is the charge increment in percentage. The independent variable is the Average Distance covered (km). Note that the three categories of distances covered is what leads to variations in charge increment. The study therefore **concluded that, as the distance covered increased, the more the charge that was recorded on the power bank.**

From the results obtained in Table 4.2 and Fig 4.2, the dependent variable is both the average pace and the increment in percentage. Student C was female and anatomically could not keep up with the male. We do not mean ladies are weaker, this could also just be a coincidence. The independent variable is the student identifier. Note that the student identifier is what leads to variations in pace and charge increment. The study **also concluded that the faster we moved over the same distance, the more the charge that was recorded on the power bank.**

From the results obtained in Table 4.3 and Fig 4.3, the Kinetic energy converted to chemical energy during forward skating for the Electronic Skate power is 1300 Joules/kg while the Kinetic energy converted to chemical energy during forward skating for the Regular Skate is 0 Joules/kg. These values were measured using the Easy count Energy meters. The Kinetic energy converted to chemical energy during forward skating for the regular Skate power is 0 Joules/kg because it does not have a mechanism (dynamo) for converting kinetic energy to chemical energy. **This therefore implies the electronic skate power is capable of converting kinetic energy to chemical energy.**

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CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

From the results observed in chapter IV above, the study therefore concluded that, as the distance covered increased, the more the charge that was recorded on the power bank. It was also noted that the faster we moved over the same distance, the more the charge that was recorded on the power bank. The study also found that the electronic skate power is capable of converting kinetic energy to chemical energy and also more efficient than a regular skate in converting kinetic energy to chemical energy. With this data, the study has proved the hypothesis, answered all the research questions and achieved all the specific objectives.

5.2 Recommendations

This study recommends that the Electronic Skate power Bank be implemented as one of the modes of transport in order to minimize foreign consumption of energy. . This study recommends that since skating is an exercise and can help improve health and hence minimize lifestyle diseases in the developing countries, the Electronic Skate power Bank should be sensitized among many travelers hence a solution to "Health", which is a key pillar of the Big 4 agenda of the government of Kenya.

5.3 Future Adjustments

In future, this study plans to convert and use the energy stored in the power bank during skating in powering the skateboard when the person becomes tired in skating manually and hence the skater can enjoy an automated skating therefore achieving Newton's Law of motion which states that energy is neither created nor destroyed but is converted from one form to another.

5.4 Linkage to emerging issues

Presently pollution is one of the biggest contributors of global warming. This in turn affects the attainment of the social pillar of the vision 2030. With the adaptation and implementation of the electronic skate power bank as one of the modes of transport, pollution will be significantly minimized. Lifestyle diseases is another emerging issues leading to reduced life expectancy. Use of the electronic skate power bank will oversee transport being done at the same time as exercise which is key in minimizing very many lifestyle diseases.

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APPENDICES

APPENDIX I: LETTER TO THE RESPONDENT

Dear Respondent,

I am currently a teacher at St Angela Sengera Girls' High School, Kenya. My Science club students are currently carrying out a research study on a project whose topic is:

"ELECTRONIC SKATE POWER BANK".

I therefore request for your information and cooperation in this exercise. All information will be treated with confidentiality.

Yours with regard

DR. DENNIS OSORO MARANGA
PhD (FINANCE)
KENYATTA UNIVERSITY