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Dean's Message

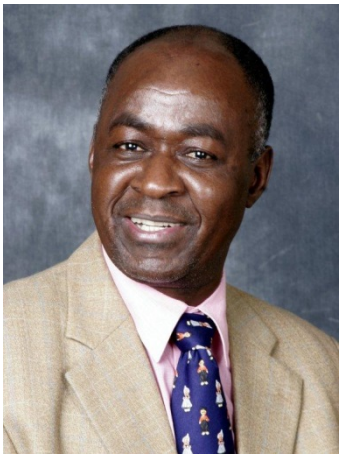
Executive Dean CSET, Prof Moche

Promoting interest in science through research is one of the ways that the College of Science, Engineering and Technology (CSET) has been engaging with school learners. For the college, this initiative is important to not only encourage a sense of interest in science, but to also expose students to proper ways of "doing" science. The learners work under the mentorship of a member of the academic staff on a predetermined topic and present their results at an annual summit. Thus far, the college has hosted three summits. The 2014 summit was hosted in collaboration with the College of Law as an attempt to infuse multidisciplinarity into this initiative. This edition contains the result of presentations from the 2014 summit. The learners focused on several topics, but mainly on crystallography as the core theme. The college sees this edition as a first step towards a publication that will promote a science discourse amongst learners; a publication that will showcase the fact that it can never be too early to engage in research.

Prof IOG Moche

Executive Dean, College of Science, Engineering and Technology

LRS Chairperson Message



LRS chairperson, Prof Ohanga

The CSET at the University of South Africa (Unisa), engages with many communities as part of its community engagement initiatives aimed at promoting Science, Engineering, and Technology (SET) as a possible career choice to learners. The college does this in a variety of ways ranging from outreach initiatives to activities promoting engaged scholarship. Consequently, the College has initiated a Learner Research Summit (LRS). The summit is not only aimed at promoting SET as a possible career choice to learners but focuses largely on fostering their research skills. The learners are given topics (from the summit themes) to research and the college's academics in collaboration with the College of Law's academics guide them through their research. This is done in partnership with the educators. This initiative is aimed at learners in grades 8 up to 11. CSET academics facilitate learners in the development of research skills investigating topics/projects relevant to the theme(s). Learners in collaboration showcase their innovative research projects/findings during a scheduled Learner Research Summit. During the Learner Research Summit, the learners showcase their findings through either an oral presentation or a poster presentation. The Learner Research Summit is now in its second year running, having started in 2013. The Learner Research Summits have been held at Unisa, Pretoria, Florida campuses and at EPP Mhinga High School in Malamulele, Limpopo Province. The main goal is that eventually the Learner Research Summit will transform into a national Learner Research Conference.

Prof MO Ohanga

LRS Chairperson, School of Engineering

CSET Community Engagement Chairperson Message

CSET Community Engagement chairperson, Prof Dube

The Learner Research Summit is a Community Engagement initiative from the College of Science Engineering and Technology (CSET) together with the College of Law that in a way affirms the vision of UNISA, which is "The African University Shaping Futures in the Service of Humanity". This initiative was designed with the purpose of enabling young minds to think creatively and critically and also to have a desire to solve problems within their communities. LRS is a platform where young learners, both from high school and primary school, are drawn into the excitement of the world of research and discovery. In 2014 LRS celebrated its second year with yet another successful event where we saw a great improvement in the type of research work delivered as well as in the presentations that the learners delivered confidently to peers and academics from UNISA. Learners researched, under the mentorship of CSET academics and educators, within very critical and challenging topics of 'World Class Learning Unleashed", "Crystallography" and "Sustainable Energy". Despite the complexity of the themes, the learners gave very interesting views on the topics and delivered some excellent presentations. Such a platform is encouraged as it creates an exciting space of learning where the students are exposed to knowledge in an exciting way and they own the learning process as they view themselves as problem solvers. We believe that such an initiative will assist learners with their research work in their curriculum since they would have covered research methodology. This LRS publication serves as a confirmation of UNISA's commitment to engage with communities in studying natural sciences, and discovering and explaining fascinating phenomena.

Prof S Dube
CSET Community Engagement Chairperson

Editorial Team Chairperson Message

Editorial team chairperson, Prof Coleman

In order to achieve the objectives of strengthening research skills of school learners in SET, and to instil research interest in the learners, the following were articulated:

The learners were requested to write up their projects in article format at their own free time. The write ups were reviewed by a panel of CSET academics. A selection of articles was made for the Learner Research Summit (LRS) publication. The LRS publication will serve as evidence of learners work, motivation to other learners and unleash the potential of learners in conducting research.

The editorial team has been responsible for the following:

- Layout and formatting of articles according to the publication's requirements
- Content and language editing of papers
- Compilation and sequencing of articles
- Coordinating publication design and printing

It is our sincere hope that you will find the articles exciting and a rewarding experience in exploring scientific discoveries conducted by the learners.

Prof A Coleman

Chairperson, LRS Publication Editorial Team

A Tool for the Innovative Learning of Biology - S1M₂

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Abstract – *The theme for the 2014 FIRST Lego League Competition (FLL) was Learning Unleashed. The FLL robotics teams were required to research innovative options for learning a specific topic or subject in the 21st century, from the perspective of the learner. As Team Square 1 we chose the subject Biology with the aid of Mathematics. This research focused on learning Biology with an aspect of Mathematics. The team developed an interactive game to assist in the learning of the human body by associating Biology learning content with Mathematical problems. The proposed approach could be used for any level of learning, from pre-primary to university. In a survey that was conducted as part of this research, the learners were asked their opinion on the approach. Results indicated that the approach would be of great assistance. Additional modules for other Biology learning concepts will be developed to enhance this initial development in future.*

Keywords: learning, Mathematics, Biology, interactive, game

1 Introduction

The theme for the 2014 FIRST Lego League Competition (FLL) was Learning Unleashed. The FLL robotics teams were required to research innovative options for learning a specific topic or subject in the 21st century, from the perspective of the learners. The research conducted by Team Square 1, a rookie team for 2014, focused on the use of Mathematics and a model in learning Biology for all levels of the subject Biology. Biology is taught and learnt at all levels of learning, from the basic naming of Biology parts and structures to the description and understanding of processes in complex biological systems. Usually, in classroom lesson sections are taught using diagrams and written notes. However, oral explanation and reading is not the most effective way of learning a topic. We propose an interactive game that will ensure that learners are involved and participate in learning, ensuring that the learners remember while having fun.

2 Literature and Internet Research

The team considered a range of literature options as background for the research to determine reasons for the ineffective teaching of Biology (and Mathematics) in South African schools. Internet articles and an interview with a professor were the basis of the literature review.

2.1 Expert opinion-Interview with the Professor

The team interviewed Professor Poobablan Pillay. He has been teaching for many years. According to him, to improve the teaching of Biology, the learners must participate in the learning, and an integrated approach is required.

2.2 Internet articles

The team focused on the learning of Biology, and ways to improve the schooling in South Africa [5]. The aspect of readiness was also considered. The importance of learning general sciences (including Biology) are in the news in terms of the levels of difficulty to bridge the gap and the readiness of the students has been noted [3]. The statistics of entry level courses have been highlighted in terms of readiness in the sciences [1]. The ranking of South Africa compared to world countries in terms of the teaching and learning of science and Mathematics in the world has also been in the news. South Africa as a country is ranked among the worst performing countries [4]. It was also noted in the news that an overall overhaul of the education system in the country is required otherwise learners are considered ill-prepared for life [2].

3 Survey-Pilot Test

The initial design of the game was presented to an educator at the school, and also to groups of learners. The ideas and concepts

shared ensured that the original idea was enhanced. The pilot test required only one aspect of the human body and thus the team selected the lungs. The body part should also be appropriate to the age of the learner and the complexity of learning required (e.g. the university level differs from primary level).

4 Model-The Lung

In preparation for the North Gauteng Regional competition, the team developed a cardboard template version of the model. An initial model built from Lego was presented at the competitions, which has been modified and improved for the FLL National. The model is now more advanced and has branding.

The model is an image of a human lung. There are black pieces of Lego that are used to depict the parts of the organ that need to be labeled. The number of the label corresponds with the cards that have Mathematical questions to guide the learner to the correct answer. A Mathematical basis was used as Mathematics is an exact science to ensure that the learner arrives at the correct answer.

The lung model is community friendly as it can be downloaded from the internet (the template), it can be built out of Lego blocks, or it may be purchased as a kit for the schools. These distribution options need to be investigated and will be considered for future competitions.

5 The Model Evaluation

The mode has been on display in the Robotics Room at the school. The learners and teachers are free to play with the model at all times. We showed and demonstrated our model to the other I-SET teams. Evaluation questionnaires were developed; however, survey administration was constrained by time and was fast forwarded into future work.

6 Conclusion and Future Research

As a team we intend to increase awareness of innovative options for teaching Biology. The initial model has branding and is well packaged. In future research, the team intends to incorporate mechanisms and improvement to address learning disabilities and the five senses of learners. The team further intends to enhance and extend the current model to include all body parts (animals and plants) and other Biology learning units. The distribution options to ensure that all South African learners have access to this innovative learning for Biology will also be investigated in the future. The team further intends to extent their application to include levels of increasing complexity.

7 Acknowledgements

The authors would like to thank UNISA's College of Science, Engineering and Technology for inviting them to be part of the summit. Special thanks to the mentors for a great time and learning experience.

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How Solar Energy Can Power a Car

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Abstract – *In this paper we investigate solar energy as a form of renewable energy that could be used to power a car. A literature review was performed and different mechanisms of solar energy capture and conversion from radiant heat energy to useful electrical energy, and the amounts of power provided were considered. Theoretical considerations such as the effects of the different types of renewable energy utilization on the ozone layer and the crystallography of silicon solar cell panel types were investigated. We examine factors inclusive of the power density, cost, and design specifications and constraints for a practical car to adequately function and make a comparison of these factors amongst the different types of renewable energy inclusive of practical effects such as the size and type of batteries to use in a solar powered car. Our conclusion is that solar energy can be used to power appliances while not polluting the environment.*

Keywords: renewable energy, solar energy, crystallography, solar vehicle, physics, climate change.

1 Introduction

What is Solar Energy? Solar energy is radiant light and heat from the sun that is harnessed using a range of ever-evolving technologies such as solar heating, solar photo voltaic, solar thermal electricity, solar architecture and artificial photosynthesis. The earth receives an incredible supply of solar energy. The sun, an average star, is a fusion reactor that has been burning over 4 billion years. Solar energy is an inexhaustible resource, yet harnessing, is a relatively new idea. The ability to use solar power for heat was the first discovery. The second discovery was the production of electricity from solar energy. In the 1880's selenium photovoltaic (PV) cells were developed that could convert light into electricity with 1-2% efficiency but how the conversion happened wasn't really understood.

The earliest known record of the direct conversion of solar radiation into mechanical power belongs to Auguate Mouchout, a mathematics instructor at the Lyce de tours. Mouchout began his solar work in the 1860's after expressing grave concerns about his country's dependence on coal. The reason why renewable resources are necessary because non-renewable resources such as oil and coal will eventually run out, whereby they will stop providing us with energy. Renewable resources can be used to provide us with energy as well after non-renewable have been exhausted.

Renewable energy is generally defined as energy that comes from resources which are naturally replenished on a human time scale. For example, sunlight (solar energy), wind, rain, tides, waves and geothermal heat. Renewable energy is cost effective. It lowers the level of pollution thus decreases global warming. Renewable energy is also important as it provides benefits such as a secured source of energy for generations to come.

2 Literature Review

In August 1955, William G Cobb of the General Motors Corp. (GM) demonstrated his 15 inch long "sun mobile", the world's first solar powered automobile, at the General Motors Powerama Auto Show held in Chicago. Cobb's "sun mobile" briefly introduced the field of photovoltaic. This is the process by which the sun's rays are converted into electricity when exposed to certain surfaces into the gasoline-drenched automotive industry. When sunlight hit 12 photoelectric cells made of a non-metal substance with conducting properties called selenium, built into the sun mobile, an electrical current was produced that in turn powered a tiny motor.

The motor turn the vehicles driveshaft, which was connected to its rear axle by a pulley. Visitors at the month long, $7 million powerama marveled at same 250 free exhibits spread over

one million square feet of space on the shares of Lake Michigan. In addition to Cobb's futuristic mini-automobile, powerama visitors were treated to an impressive display of GM's diesel fuelled empire, from oil wells cotton gin's to submarines and other military equipment.

In 1962 when the first solar car that people could drive was presented to the public, the international rectifier company converted a vintage model 1912 baker electric car to run on photovoltaic energy in 1958 but they only presented it to the public after 4 years. Around 10 640 individual solar cells were mounted to the roof top of the baker to propel it.

An Alabama university professor, Ed Passereni, built the blue bird solar car in 1977, which was a prototype full scale vehicle. The blue bird was created to move from power generated by the photovoltaic cells only without the use of a battery. The blue bird was exhibited in Knoxville, at the 1982 world's fair. Between 1977 and 1980 (the exact dates are not known) at the Tokyo Denki university professor Masaharu Fujita first created a solar bicycle, then a 4-wheel car. The car was two solar bicycles put together.

In 1979, Englishman Alain Freeman invented a solar car. He drove the same vehicle in 1980. The Freeman solar car was a three wheeler with a solar panel on the roof. At the engineering department of Tel Aviv University in Israel, Arye Braunstein and his colleagues created another solar car in 1980. The solar car had a solar panel on the hood and on the roof of the Citi car compressed of 432 Citi car creating 400 watts of peak power. The solar car used 8 batteries of 6 volts each to store the voltaic energy. In 1981 Hans Thalstrup and Karry Berkins built a solar race car. In 1982, the pair became the first to cross a continent in a solar car, from Perth to Sydney, Australia. Thalstrup is the creator of the world solar challenge in Australia.

In 1984, Greg Johnson and Joel Davidson invented the sun runner solar race car. The sun runner set the official Guinness world record in Bellflauer, California of 24.7 mph in the Mojave desert of California and final top speed of 4.1 mph was officially recorded for a "safety solar powered vehicle" (it didn't use a battery). The 1986 Guinness book of world records publicized official records.

The GM sun racer in 1987 completed an 1856 mile trip with an average speed of 42 mph. Since this time there have been many solar cars invented at universities for competitions such as the shell eco marathon. Amongst the list of key proponents of this technology are Mazda and Ford. It is said that the Mazda environmental initiative is to use existing technology to maximize driving efficiency while keeping this technology affordable for everyone. The president for Mazda North American operations further said this would help mountain harmony with nature in their business activities worldwide.

Mitsubishi electric photovoltaic modules are now powering Mazda's automotive research and development faculty. The Mitsubishi electric estimates the PV system will supply more than 489.684 kilowatts/hour annually and with the clean energy produced over the systems expected lifespan of 25 years it will prevent an estimated 18.6 million pounds of carbon dioxide from entering the atmosphere. This is equivalent to the emissions resulting from burning 19.625 barrels of oil. Furthermore for every Mazda car equipped with Skyactiv technology the fuel mileage is managed, these models include the 2014 Mazda 3, 2014 Mazda 6 and the first vehicle to debut with the full-size of Skyactiv, the CX-5 CUV.

The ford solar car concept is a plug-in hybrid electric vehicle with solar panels on the roof which allows the car to recharge itself. The vehicles total range is 620 miles, and it can travel 21 miles using only electric power from the sun. This concept is not dependent on the traditional electric grid for its battery power. This vehicle will be tested in numerous real-world scenarios. The outcome of these tests will determine if the concept is feasible as a productive car.

3 Types of Solar Panels

This section discusses the available solar panel types as follows:

- Crystalline module (monocrystalline or polycrystalline): they perform in a very similar way and take up roughly the same amount of space.
- Hybrid panels: are a cut above crystalline ones in terms of efficiency, they generate a larger power from a smaller area but are too expensive compared to crystalline panels. They are not worthwhile unless there is a limited space.

- Thin film modules: they take up more space than other types and are much cheaper.

Black framed panels, and even the latest "all black" panels with black frames and backing has a better appearance ten standard aluminium framed panels. They get a lot hotter which will cause the solar cells to work less efficiently and will generate less electricity. One would pay more for the panels which generate less.

4 Benefits of Solar Panels

- Monocrystalline panels: the entire cells are aligned in one direction which means that when the sun is shining brightly on them at the correct angle, they are extremely efficient. They have uniform black colour because they are absorbing most of the light.
- Polycrystalline panels: these individual crystals are not necessarily all perfectly aligned together and this may help in some circumstances because some of these cells work better from light at all angles, in low light etc. Since they are cut into rectangular blocks there is very little space on the panel and you don't see the little diamonds that are typical of mono or hybrid panels.
- Hybrid panels: the extra amorphous layer extracts more energy from the available sunlight particularly in low light conditions. These are the most efficient panels available so they take up the least space on your roof. If you have a very small roof you can extract the maximum amount of energy from it.
- Black frames and black backed panels: they give a much better appearance.

5 What Amount of Power can Solar Panels Provide?

A solar panel can be used as a component of a larger PV system (a packaged, connected assembly of solar cells) to generate and supply electricity in commercial and residential. Standard test conditions (S + C) rates each module by its dc output efficient 230 watts module will have twice the area of a 16% efficient 230watt module. It also depends on the sunlight hitting the panel, the size of the panel and the efficiency of the solar cells inside.

6 Theoretical Research

Every single day sources of petroleum that can be converted to petrol to drive cars are decreasing. Every day more and more harm is being done to the ozone layer. Cars (powered by petrol) release poisonous gases that harm to the ozone layer. Some of the main ozone-depleting substances are chlorofluoro carbons (CFC's), hydro chlorofluoro carbons and volatile organic compounds, also known as tsunami's, earthquakes and floods. Therefore there is a need to find alternative solutions which will bring no harm to the ozone layer and will also manage to drive cars. One alternative solution is solar energy. The main component of a solar car is its solar array, which captures the energy of the sun and converts it into usable electrical energy.

The sun shines heat energy and the solar cells collect portions of the sun's energy and store it into the battery of the solar car. But before that happens, power trackers converts the energy collected from the solar energy to the proper system voltage, so that the batteries and the motor can use it. After the energy is stored in the batteries, it is available for use by the motor and the motor controller to drive the car. Thereafter the motor controller adjusts the amount of energy that flows to the motor to correspond to the shutter. Then the motor is supplied with the energy and uses the energy to drive the wheels.

6.1 Capturing of Solar Energy

Solar energy can be captured in many ways but the most common ways are by the use of photovoltaic cells and silicon panels.

Photovoltaic cells: these convert energy from the sunlight into a flow of electrons (electricity). This is a method of generating electrical power by converting solar radiation into direct current electricity using semi-conductors that exhibit the photovoltaic effect.

The photovoltaic effect refers to protons of light exciting electrons into a higher state of energy allowing them to act as charge carriers for an electric current. Solar photovoltaic power generation has long been seen as a clean energy technology which draws upon the planet's most plentiful and widely distributed renewable energy sour, the sun. The technology is "inherently elegant" in that direct conversion of

sunlight to electricity occurs without moving parts or environmental emissions during operations.

Silicon panels (cells): These are semi-conductors of electricity. When a photon (a particle of light) from the sun strikes a chip, the photon unbinds several electrons in the semi-conductors and creates a voltage. The chip is then connected to an external circuit. Silicon solar cells trap and absorb approximately 75% of all sunlight incidents (400nm-1200nm) with an equivalent bulk thickness of only 1 micron of silicon.

This is achieved by sculpting the collecting zone into a three dimensional, simple-cubic-symmetry, photonic crystal consisting of modulated siliconnanoures embedded in silicon oxide and sitting on a quarts sub state with no metallic mirrors. A specific nanoures provides antireflection, strong light trapping, and buck reflection mechanisms in targeted spectral regions.

There are a number of limitations for using photovoltaic cells in vehicles:

- Power density: Power from a solar array is limited by the size of the vehicle and area that can be exposed to sunlight. This can be overcome by adding a flat board and connecting it to the car and this gives more area for panels to power the car.
- Cost: while sunlight is free, the creation of PV cells to capture that sunlight is expensive. Costs for solar panels are steadily declining (22% cost reduction per doubling of production volume).
- Design and Consideration: PV cells have a lifespan when going through sunlight. The life time of a solar module is approximately 30 years.

6.2 Solar Energy into Electrical Energy– Energy Directly Into Motors

A solar powered DC motor is a simple demonstration of how solar power can be used directly in some applications. Solar panels transform light energy into electrical energy. The electrical energy from the solar panel is direct current (DC) electricity so it can be used by motors that run on dc electric power. If we hook up a solar panel directly to dc electrical motors, then the solar panel is sending power directly to the motor and the motor is using the electrical energy immediately. In this case the motor is directly powered by solar energy. The goal of solar vehicles is to reduce air emissions associated with typical internal combustion vehicles(ICV's) hereby decreasing the emission of environmentally damaging products such as carbon dioxide and nitrogen oxides.

6.3 Battery Powering Motor

If we hook up the solar panel in a parallel circuit with a motor and a battery then the solar panel will charge the battery and the dc motor will get direct electrical energy from the battery. The energy used to power the motor came from the battery. However the energy in the battery came from solar energy. The motor is indirectly powered by solar energy and directly powered by the battery.

7 Conclusions

Solar cars harness energy from the sun converting it into electricity. That electricity then fuse the battery that runs the cars motor. The battery gives off electric energy to the motor which allows the wheel to move. Our project was very productive. Our hypothesis was: we think solar energy can be used to power appliances while not polluting the environment.

8 Acknowledgements

The authors would like to thank UNISA's College of Science, Engineering and Technology for inviting them to be part of the summit. Special thanks to the mentors for a great time and learning experience.

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Comparing the Three Types of Vehicles: Solar, Electric and Biofuel Powered Vehicles

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Abstract – *Different types of environmental friendly cars also called green cars have recently been developed in order to address the environmental challenges that result from toxic emissions from other types of cars. Examples of green cars include solar, electric and biofuel cars. This research conducted a comparison on characteristics of the green cars. Three types of green cars are covered in this paper including solar, electric and biofuel powered cars.*

Keywords: Solar, electric, biofuel

1 Introduction

Vehicles have been produced and used since the late 1800s. Different types of vehicles have been developed over the centuries and the car industry has seen huge improvements in terms of shapes, power, fuel efficiency and technology among other developments. There have been many benefits associated with using vehicles despite the disadvantages associated with its use or abuse. Recently the focus has shifted to environmental impact of production and use of vehicles. A number of efforts are currently under way by governments and car manufacturers in order to reduce the environmental impacts caused by cars. One area has been the emission cars produce into the environment that is a general result of the source of energy used in a particular vehicle. This paper analyses three types of vehicles sources of energy namely electric, solar and biofuel. The paper aims to outline the advantages, disadvantages and most importantly the environmental impact of a particular source of energy used to power a vehicle.

2 Electric Cars

An electric car is an automobile that is propelled by one or more electric motors, using electrical energy stored in batteries or another energy storage device. Electric motors give electric cars instant torque, creating strong and smooth acceleration. The number one advantage of an electric vehicle is that no gas or fuel is required. One example of such a car is the Chevy Volt. It has a battery range of 40 miles which is more than the range of an average commuter to work in many urban areas. This entails that one can go to and from work using electric car without gas. With minimal gas usage comes great savings. The Chevy Volt has an option to use gas in case the battery runs out or there is need to travel a long distance. However, the amount of fill ups per year are much fewer with an electric vehicle. You can plug the car into any outlet of the proper voltage and charge the car battery.

Furthermore electric cars give off no emissions. Hybrids running on gas give off emissions, while electric cars are totally 100 percent free of pollutants. Safety is a big concern with these vehicles. However, the fluid batteries actuality take impact better than a fully made gas cars, and can help even more in the event of an accident

The main disadvantage for electric cars is the price. Electric car batteries are not cheap, and the better the battery, the higher the price. For example, the Chevy Volt has a 40 mile range and sells for around $30,000. Compare that to the 250 to 300 mile range of cars made by Tesla Motors, which sell for anywhere between $50,000 and $100,000.

The other disadvantage is the low engine sound. Even though it is a quiet ride, silence can be seen as a disadvantage. People like to hear cars when they are coming up behind them or beside them. The silent engines of electric cars have been to lead to accidents.

Additionally most electric cars take a long time to recharge their batteries. Tesla Motors' Models can recharge in 45 minutes, but most electric cars take hours to recharge. Most electric cars currently on the road do not have long ranges. Although in the future it will improve,

most of the cars have a range of less than 25 miles.

2.1 Transmission in electric cars

The electric car is propelled purely by electricity, so it does not burn fuel or emit any carbon dioxide (CO_2) when in motion. With further technical progress and the growth of an infrastructure with a dense network of electric tilting stations, vehicles driven by electric power alone will become more widespread on the market. They are a milestone on the path to independence from fossil fuels and will in future make a mobility possible that is equally economical as it is free of CO_2 production. The electric axle drive unit sits directly on the axle and includes a separate motor generator which drives the vehicle electrically when functioning as a motor and helps to transform mechanical braking energy into electrical energy when functioning as a generator.

The power electronics is the connection between the battery and the electric machine. It converts the direct current of the high-performance battery into the alternating current required to power the electric motor. Traditional braking maneuvers represent a waste of the kinetic energy that has only just been generated via fuel combustion. The cooperative regenerative braking system ensures that as much braking energy as possible is recuperated and stored as electrical energy. To do this, the generator is used to slow the vehicle down. As soon as the braking requirements exceed the braking capacity of the generator, the classic wheel brakes are applied. The battery supplies the electric machine during electric propulsion. When driving with the combustion engine and during regenerative braking, the battery is charged by the electric machine.

2.2 Concerns about electric cars

Electric vehicles are seen by governments as an important part of cutting emissions and reducing global warming. After all, what comes out of the car is completely clean, but nonetheless some scientists are questioning their green credentials. The main concern with electric cars is on how electric vehicles (EVS), and particularly their batteries are manufactured and how the electricity which powers them is generated. One recent study by scientists in EV-friendly Norway has found that in some circumstances electric cars can have a greater impact on global warming than conventional cars. One of the authors of the report, at the Norwegian University of Science and Technology, Guillaume Majeau-Bettez, admits that he is shocked and disappointed that their findings are not more positive for EVS. "The electric car has great potential for improvement, but ultimately what will make it a success or failure from an environmental standpoint is how much we can clean up our electricity grid both for the electricity you use when you drive your car, and for the electricity used for producing the car.

The study is a life cycle analysis of the global warming impact of the production and operation of EVS, driven for 150,000km (93,750 miles), compared with the production and operation of conventional cars. The scientists include so-called "well to wheel" data, taking into account the energy needed to refine and transport oil into petrol or diesel. One of the findings is that the energy intensive manufacturing of EVS means that some oars make almost double the impact on global warming as conventional cars. This is mostly because of the raw materials and energy needed to build the lithium-ion batteries. However, the moment a new EV hits the road, the environmental picture starts to improve.

3 Solar Vehicles

A solar vehicle is an electric vehicle powered completely or significantly by direct solar energy. Usually, photovoltaic (PV) cells contained in solar panels convert the sun's energy directly into electric energy. The term "solar vehicle" usually implies that solar energy is used to power all or part of a vehicle's propulsion. Solar power may be also used to provide power for communications or controls or other auxiliary functions. Solar vehicles are not sold as practical day-to-day transportation devices at present, but are primarily demonstration vehicles and engineering exercises, often sponsored by government agencies.

Unlike regular cars, solar energy powered cars are able to utilize their full power at any speed. Additional advantages include:

- Cheaper to run as they do not require any expense for running and therefore have very low maintenance costs.
- Solar cars produce very minimal noise and no harmful emissions.

There are also disadvantages associated with solar cars and the notable ones include:

- Solar cars don't have speed or power that regular cars possess.
- Solar powered cars can operate only for a limited distance if there is no sun and becomes unreliable in cloud conditions.
- Initial cost is another deterring factor for solar cars, a good solar powered car can cost up to $200,000 or more.

Environmental impact of using solar energy is negative at the start with the cost of the materials and production of the equipment. During production solar panels leftover materials such as Silicon Tetrachloride have to be carefully disposed as they can cause pollution. The negative impacts are balanced out by the positive features of generating your own electricity from the sun.

4 Biofuel Vehicles

Biofuel is a type of fuel that is derived immediately from living matter. Fuel such as methane produced from renewable biological resources such as paint biomass and treated municipal and industrial waste. First known use of biofuel dates back in the 1970s. Biofuels are mainly made from plant and plant-derived substances known as biomass. The energy in biomass originally came from the sun through photosynthesis, a process that harnesses sunlight to turn carbon dioxide and water into sugars. Plants then use the sugars to create carbohydrates and cellulose that can later be turned into fuel.

Palm oil is used in Thailand as the main ingredient for biofuel. Biofuel includes any solid, liquid, or gaseous fuel produced either directly from plants or indirectly from organic industrial, commercial, domestic, or agricultural wastes. In principle, burning biofuels adds less carbon into the atmosphere than burning fossil fuels because the carbon atoms released by burning biofuel already existed as part of the modern carbon cycle. Burning fossil fuels, on the other hand, always adds extra carbon because the carbon they contain corns from a buried source that was not part of the modern carbon cycle.

There are three main methods of producing biofuels:

1. The burning of dry organic wastes (such as household refuse, industrial and agricultural wastes, straw, wood, and peat);
2. Energy forestry (producing special fast-growing trees for wood that can be burned as fuel); and
3. The fermentation of wet wastes (such as animal dung) in the absence of oxygen to produce biogas (containing up to 60 per cent methane), or the fermentation of sugarcane or com to produce alcohol and esters.

4.1 Biofuel production and concerns

The most widely used liquid biofuel in industrial countries is ethanol. In the United States in 2005, 3.9 billion gallons of ethanol were produced, mainly from corn. Most of that ethanol was blended with gasoline, accounting for 2.8 per cent of total yearly gasoline sales. The European Union (EU) produced 718 million gallons of ethanol in 2005, mostly distilled from sugar beets and wheat grain. The EU has set goals that 5.75 per cent ethanol derived from wheat, beets, potatoes, or corn, be added to fossil fuels by 2010 and 10 per cent by 2020. Brazil is the world's largest producer of ethanol. About 15 per cent of its liquid fuel is ethanol derived from sugarcane. Gasoline sold in Brazil is usually mixed with 25 per cent ethanol. Many automobiles in the country have "flex-fuel" engines that can use either gasoline or pure ethanol. The use of biodiesel is also increasing, often blended with diesel derived from petroleum. In 2005 the EU produced 858 million gallons of biodiesel, primarily from rapeseed oil. The United States produced about 250 million gallons of biodiesel in 2006, nearly all of it from soybean oil.

Politicians, scientists, and economists have promoted biofuels as renewable energy sources that add less carbon to the environment and provide energy independence. However, some experts have raised concerns about possible negative consequences of growing crops to provide biofuels. Food prices may rise if a major percentage of grain crops are grown for energy and if areas once used to grow food are converted to energy crops. The price increases could affect impoverished populations especially

in developing countries. Rain forests and other tropical areas could be cleared to cultivate crops such as oil palm and soybeans, at the same time displacing populations in regions such as Southeast Asia and the Amazon.

4.2 Biofuel vehicles energy and transmission

Mixture of volatile, flammable hydrocarbons derived from plant material or animal waste are used as fuel. Some long-exploited biofuels, such as wood, can be used directly as a raw material that is burned to produce heat. The heat in turn can be used to run generators in a power plant to produce electricity. Sugars and starches from sugarcane, corn, and high cellulose plants (such as switch grass) can be converted into ethanol, which is used directly in internal-combustion engines or is mixed with gasoline (gasohol). Oils from plants such as the soybean or oil palm can be chemically processed and blended with petroleum diesel fuel to make biodiesel.

The basic elements of an automatic transmission are a gearbox and a torque converter, which uses fluid to transfer energy from the engine to the gearbox. An automatic transmission is designed to automatically adjust its gear ratios according to vehicles acceleration and road speed, and the strain on the engine. The drive components are engaged and disengaged by changes in the pressure of special oil, called transmission fluid, inside the transmission. Sensors, control modules, and valves direct the flow of transmission fluid.

The basic four-speed manual transmission has an aluminium housing called the transmission case, an input shaft that is turned by the engine, and an output shaft that transmits power to the axle. Inside the transmission case, 11 gears-steel wheels of various sizes with deep grooves or teeth around their edges-are arranged on the shafts. The teeth of the different wheels mesh together, enabling one gear to cause the other to turn. Some of the gears are located on a third shaft called a countershaft.

The gearshift controls levers and selector forks that move the gears along the shafts and cause them to mesh. The gears rotate in a bath of heavyweight transmission oil.

- *How it works:* The torque or twisting force, of the engines crankshaft is passed along by mechanical linkage to a rotating shaft that enters the transmission. A gear at the end of this input shaft meshes with a gear on the countershaft, causing the countershaft to rotate. Gears of different sizes attached to the countershaft drive other gears on the input and output shafts. The gearshift enables the driver to select different combinations of gears to determine how fast and with how much torque the output shaft turns. Because they are connected by gears and other devices, the rotating output shaft turns the driveshaft, axles, and wheels.
- *Gear Ratios:* Each combination of steel gears in the transmission is referred to as a cluster. In each cluster, a larger-diameter gear meshes with a smaller diameter one. Difference in the sizes of these two gears creates a gear ratio. The amount of torque applied to the output shaft depends on the size of this ratio. In the Lowest gear (usually called first gear); a smaller gear turns a larger one. This gear ratio causes the output shaft to rotate slower than the input shaft, but with increased torque, or power. In third or fourth gear, depending on the transmission, the gearshift meshes two gears that are the same size, producing no changes in torque or shaft speed. In overdrive, which may be called fifth gear, depending on the transmission, a larger gear drives a smaller one. This ratio reduces torque, but enables the input shaft to turn slower than the output shaft. Overdrive is useful when the vehicles ground speed is fairly high and little power is needed to maintain it. In reverse, a special gear combination enables the transmission to turn the output shaft in the opposite direction which moves the vehicle backward. Transmissions also have a neutral position in which no torque is transferred to the output shaft.

4.3 Environmental effects of Biodiesel Fuel

Although biodiesel fuel is fast emerging as the oil of the future, a number of environmental effects of biodiesel fuel are also surfacing associated with its use. These biodiesel fuel

environmental effects potentially include decrease in greenhouse gas emissions, deforestation, pollution and the rate of biodegradation. This section discusses the effects of biodiesel fuel on environment.

Greenhouse gas emissions

Whether using biodiesel is able to lower greenhouse gas emissions as compared to the fossil fuels may depend on many factors. Carbon dioxide is known to be one of the major greenhouse gases. The plant feedstock used in the making biofuels absorbs carbon dioxide from the atmosphere when it grows and once the biomass is converted into biodiesel and burnt as fuel, the energy released is used to power an engine while the carbon dioxide is released back into the atmosphere. When considering environmental effects of biodiesel fuel due to the total amount of greenhouse gas emissions it is important to consider the whole production process. Several factors like production methods, type of feedstock play their role. Assuming today's production methods, with no land use change, biodiesel from rapeseed and sunflower oil produce lower greenhouse gas emissions than petro diesel. But calculating the carbon intensity of biodiesel fuels is a complex and inexact process. However, there is continuing research for improving the efficiency of the production process of the biodiesel fuels.

Deforestation

There can be grave effects of biodiesel fuel on the environment if deforestation and monoculture farming techniques are used to grow biofuel crops. It may damage the ecosystems and biodiversity and increase the emission of climate change gases rather than helping controlling them. To meet the demand for cheap oil from the tropical region, the amount of arable land is being extended in order to increase production at the cost of tropical rainforest` As feedstock oils in Europe and North America are much more expansive than Asia, South America and Africa, imports to these more affluent nations are likely to increase in the future. Tropics forests are being cleared to make room for oil palm plantations. These can lead to serious biodiesel fuel environmental effects as deforestation can be threatening many species of unique plants and animals.

5 Conclusions

This paper has discussed the comparison of three different types of vehicles namely electric, solar and biofuel. The paper discussed the advantages, disadvantages and environmental concerns for each type of a vehicle. Discussion in this paper aims to aid understanding of how vehicles operate and what are the costs both financially and environmentally do vehicles have while operating.

6 Acknowledgements

The authors would like to thank UNISA’s College of Science, Engineering and Technology for inviting them to be part of the summit. Special thanks to the mentors for a great time and learning experience.

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HTU Geometry Chase Application

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Abstract – *The theme for the 2014 FIRST Lego League Competition (FLL) is Learning Unleashed. The FLL robotics teams were required to research innovative options for learning a specific topic or subject in the 21st century, from the learners' perspective. The research of the Hey That's Us Team focused on the use of technology and the development of an application for the improvement of mathematics (specifically geometry) learning for learners in Grades 5 to 10. The team considered literature, existing solutions and their current problems in geometry. The team proposes an application that makes learning of geometry fun, using a theme and videos. Their proof-of-concept solution and a first version of the application were evaluated by learners and educators, thus contributing to the ongoing development and enhancement of the Geometry Chase Application and the FUN learning of geometry.*

Keywords: learning unleashed, geometry, innovation, game, application development.

1 Introduction

The theme for the 2014 FIRST Lego League Competition (FLL) is Learning Unleashed. The FLL robotics teams were required to research innovative options for learning a specific topic or subject in the 21st century, from the perspective of the learners. The research of the Hey That's Us Team (runner-up winners of the North Gauteng Regional FLL competition) focused on the use of technology for the improvement of mathematics (specifically geometry) learning for learners in Grades 5 to 10. Mathematics, specifically geometry is a challenge for many learners, and it is not taught in a fun way.

1.1 The learning of geometry

Geometry is taught to all Grades from a text book of examples and problems. The exercises focus on 2D diagrams with measurements, where learners are required to apply the theory to solve for one or more unknown values. As Geometry is such a vast topic (e.g. angles, lines, 2D shapes, 3D shapes) and the application thereof to real-world examples varies in complexity (from Pythagoras and a triangle to force diagrams in physics and the trigonometry in Advanced Mathematics), leaners are usually challenged by one or more specific sections of the geometry curriculum. However, in agreeance with [7], " Learning geometry is about more than just taking your medicine ("It's good for you!"), it is at the core of everything that exists-including you." Technology is considered a learning tool for all subjects, following the guidelines of learning by doing and interaction, despite the challenges of funding, access, skills and relevance [10]. These need to be taken into account, when considering innovative ways for the current generation of learners to learn geometry in a FUN way!

Section 2 of this research presents the literature and internet study (including websites, television shows, newspapers and magazines, applications, expert opinions). Section 3 presents the investigative survey conducted at the beginning of the team's research adventure. Section 4 presents the proof-of-concept developed for the regional competition. Section 5 presents the development of the Geometry Chase application (Version 1) in preparation for the FLL Nationals competition. Section 6 presents the proposed future development. Section 7 presents the research conclusions and recommendations.

2 Literature and Internet Study

The team considered a range of resources to ensure an overall and detailed investigation into

their research. These investigations are presented in this section.

2.1 Websites

Websites provide access to free and paid-for opportunities to learner mathematics. However, to access these sites, requires at least a laptop and access to the internet. In some cases a printer is required to print downloaded worksheets and examples. Some websites followed the mathematics syllabus and current mode of teaching (lesson, video, download worksheets), whilst others offered mathematics play options. A very limited number of sites offered geometry learning for learners beyond primary grades, and many sites had payment requirements. The websites currently available on the internet were considered in terms of fun and accessibility (i.e. free learning). A number of free sites where considered, including Math Planet [8], Kahn Academy [7], Math-Play [9], IXL Maths [6] and Education Portal [3]).

2.2 Television shows

Access to television shows via YouTube allow for repeated viewing of shows that investigate the application of geometry in the real world [11]. .

2.3 Newspapers, magazines and internet articles

It is argued that mathematics is taught from the wrong angel (a pun on geometry), and that mathematics is more than numbers [1]. Studies on children in the Amazon report that the learners thoughtlessly understand the geometrical concepts [2]. Not all articles of geometry referred to the mathematics of geometry, others consider geometry from the art perspective [12].

2.4 Apps

There are several sites that support the use of applications (apps) for the learning of geometry (e.g. Android App, Apple IStore). However, most apps were not free, requiring that the learner first pays the money before being able to evaluate or determine the suitability of the app. The free apps were however, mostly considered boring, and thus not meeting the criteria of FUN! [4] The team even found an app, Geometry Dash, that had no relevance to the learning of geometry.

2.5 Expert opinions – learning geometry

It was noted that the learning of geometry should plan to give the learner an actual, relevant and real-world learning experience so as to encourage growth and development of the geometric thinking of the learner.[13] This was supported by the experts that were interviewed by the team.

The team sought the opinion of educators and leaders in their community, including Mrs Maharag and Mrs van Niekerk (Glenstantia Primary School), Mrs Roberts (Pretoria High School for Girls), Mr Harvey (Pretoria Boys High School), and Mr Wills (UNISA ICT).

2.6 Conclusion

The learners considered all the resources in their research towards the use of technology (specifically apps) towards the innovative learning of geometry. They discussed the information in the weeks leading up to the competition, and used the relevant information in the formation of their solution.

3 Survey – Focus of Learning

The team formulated a survey questionnaire to determine the extent to which mathematics/geometry is considered as a problematic learning area. The questions focused on the challenging learning of geometry, and suggestions for themes for the innovative learning of geometry. The data collected in this survey was analyzed and presented in graphical representations. The results of the survey confirmed the team's theory that the learning of mathematics was indeed challenging.

4 Proof of Concept - Development

In preparation for the North Gauteng Regional FLL competition, the team developed a proof-of-concept app named Geometry Chase. As MS PowerPoint tool is familiar to all the team members, this was used as the tool of choice to explore the ideas and concepts of develop an exciting app for geometry.

4.1 Development of Proof of Concept

The Microsoft PowerPoint presented geometry on three levels of difficulty (easy, medium, difficult). The scenarios were themed and followed a storyline.

4.2 Stop motion animation and hyper links

The development made use of MS PowerPoint presentation, videos and hyperlinks. The team accessed the research to learn what was required [5]. Stop motion animation required that photos are taken at frame intervals for each movement of the figurine. These photos were then put into Windows Movie Maker and speeded up to make a film.

4.3 Evaluation – Geometry Chase review

For the evaluation, the team used an evaluation questionnaire to interview a convenience sample of 50 learners. The letters of consent were signed by the school principal. The computer teacher agreed to let the learners play the Geometry game in class. The learners then completed the Hey That's Us Geometry Chase Review Questionnaire. The data was analyzed and presented to the educator.

4.4 Conclusion

This proof-of-concept was presented in the Research Presentation at FLL North Gauteng Regionals. It was also tested in the pit-area by other teams. The evaluation was, however, only verbal. Most teams were impressed and offered positive feedback.

5 Geometry Chase App Development

As part of the preparations for the FLL Nationals, the team embarked on the design and development of their Geometry Chase application. They consulted with Jonathan Wessels a final year BSc (Computer Science) student from the University of Pretoria.

5.1 Application specifications

The specifications of the Geometry Chase App included:

- The structure needed to allow for enhancement, expansion and also flexibility.
- The content was based on the themes of fun, as designed by the HTU team.
- The content needed to include the videos, theory, and explanation of the application as well as the options for assessment to determine whether or not the learner had grasped the concepts.
- The levels of complexity would not refer to the Grade of the learner, as this would place barriers on the learning of geometry. The levels of easy, medium and difficult needed to include a number of scenarios of application.
- It was agreed that the initial version of Geometry Chase App would be for the Android platform (as the team members all had Android phones), and that other platforms may be considered for later versions. The Android app user interface is based on eXtensible markup language (XML)
- The learner needs to be able to keep record of progression, rather than to reset each time. This would encourage the learner to strive for higher levels of complexity, based on the understanding already achieved.

5.2 Conversion from proof-of-concept to Geometry Chase App

The videos that were embedded needed to be named according to the naming conventions required for the app template structure. Then an SQL database was created. The records of the database were the theory text, the practical explanation, the assessment question and the answer options. This data was then linked into the app structure. This structure also allows for the flexibility of changing, upgrading or modifying the content of the app.

5.3 Application distribution

The Geometry Chase App is uploaded on the Google PlayStore. The uploading required an initial once-off Google Developer account payment of 25$ for the publishing of apps. It was agreed that other app stores (e.g. SamSung Store) are considered unknown. As part of the discussions with the app domain expert, he

explained that once an app is uploaded as FREE it may never be reverted to a PAID-FOR app. The team agreed that the app would always be FREE.

5.4 Evaluation of the Geometry Chase App

The initial version of the Geometry Chase App would be uploaded for peer-to-peer review, to allow for distribution at the team's discretion and also for evaluation and meaningful feedback. The GCA will then be officially launched into the public domain on the distribution platform.

The app will be demonstrated to the teams participating in the FLL Nationals competition. Evaluation forms will be used to capture valuable feedback. This information will be used for the ongoing development of the Geometry Chase app.

5.5 Conclusion

The first version of Geometry Chase app was developed and evaluated successfully. The ongoing evaluations and subsequent development will ensure that this research project is enhanced and extended to match the learning of geometry of all learners, especially the learners in the team.

6 Future Research

The team intends to extent their application to include levels of increasing complexity. There is no limit to the examples of geometry. Similarly there is no end to the number, the complexity and the range of examples that may be included in the Geometry Chase app. There is also no limit to the imagination of creation and the fun of learning. Geometry Chase has been designed and developed to meet these requirements for innovative learning in the 21st century

7 Conclusions

In conclusion, the research problem was to research and develop an innovative way of learning geometry. The team's research progressed through the stages of literature and internet resource review, development and evaluation of a proof-of-concept, and the development, evaluation and distribution of a first version of Geometry Chase, their app for learning geometry in a FUN way! This research has contributed to the learning of geometry by all learners in the team from Grades 5 to Grade 10.

8 Acknowledgement

The team acknowledges the ongoing and appreciated the support of their coaches/mentors Colleen McKenna and Debbie Wills. The team is also grateful for the insight, wisdom and patience of Jonathan Wessels, the group's app domain expert.

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The Effect of Crystallization on the Difference between Old TV Viewing and the New (LED) TV Screen Viewing Quality

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Abstract - *The research focused on finding the effects of crystallisation of the LED TV screen and the old ("Hunchback") TV screen on TV viewing quality. A questionnaire was administered to 20 households. The majority households watch modern flat screens televisions and agree it has better quality viewing.*

Keywords: LEDs, Hunchback TV, viewing quality, TV preference

1 Introduction

Due to the increase in the demand of LED televisions, we decided to do research on television, namely of LED televisions as compared to the hatchbacks. We investigated the crystal structure of both television sets, so as to see the differences between the two television sets.

2 Aims and objectives

- To find out the differences in the crystal structure of LEDs and old hatchbacks.
- To find out which type of television is mostly preferred between LEDs and hatchbacks.
- To determine what type of television screen produces better quality viewing.

3 Literature review

Television became commercially available in a crude experimental form in the late 1920s. An improved form was popularized in the United States and Britain. After 2010, most of the TV sets sold were flat-panel, mainly LEDs. According to Wikipedia, liquid crystal structure of the modern flat screen television outputs a number of advantages. Some major advantages include: These types of televisions are longer lasting. Flat screens produce a much smoother picture and better brightness in terms of image quality. The pixels don't flicker giving a better immersion experience. Flat screens have exceptional image stability, thus you do not experience eye fatigue. Our research will prove if these advantages aren't just proposed but are real.

As perfect as these flat screens appear to be, they also have quite a number of disadvantages and these include:

The flat screens are expensive in the sense that you pay a lot to buy them and they use up a lot of electricity. The flat screens televisions are more likely to get stolen. The old Hunchback however uses the usual glass crystal which did not have much trouble to gather.

4 Methodology

We administered a questionnaire to 20 households and the list of questions is as follows:

1. What type of television do you use in your home? We gave them these options: Old Hunchback, Modern LED and Both.
2. Flat screens produce a better quality image.
3. Flat screen televisions affect eyesight less.
4. Owning and maintaining televisions it expensive.
5. There is a high rate of stolen flat screens.

For questions 2 to 5 we gave them the options:
AGREE, STRONGLY AGREE, DISAGREE and STRONGLY DISAGREE.

We then counted the number of people who agreed, strongly agreed, disagreed and strongly disagreed to help us in analysing our results. Pie Charts were used to analyse the data from the questionnaires.
We also used the internet to gather information about the old hunchbacks and the modern flat screens.

5 Findings

Our main findings are summarised below.

The majority of households own modern flat screen televisions. The least number owns both types of television sets as shown in Figure 1.

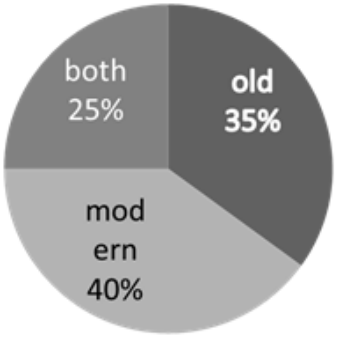

Figure1: Ownership of types of TVs by households

The pie chart in Figure 2 shows households perception of flat screens affecting eye sight. The majority agree that flat screens affect eye sight less (i.e. lead to less eye fatique) as compared to the Hunchback.

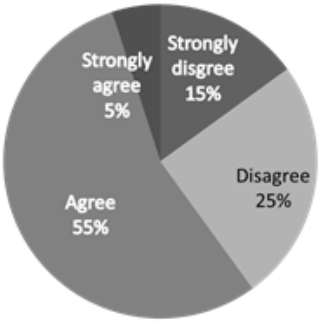

Figure 2: Flat screen TVs have less adverse effects on eye sight

The pie chart in Figure 3 shows households perception on the quality viewing of flat screens. The majority of households strongly agree that flat screens produce better quality viewing.

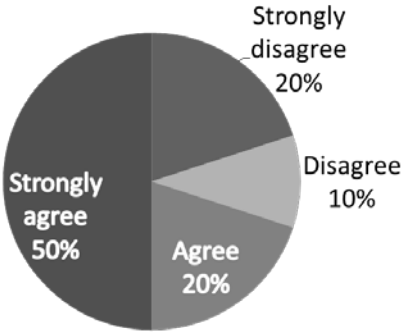

Figure 3: View quality of the TV screens better for flat screens

The pie chart shows households perception of flat screens affecting eye sight. The majority agree that flat screens affect eye sight.

6 Conclusion

The majority of households watch modern flat screens televisions and agree that it has better quality viewing In view of the higher price of the flat screen TVs, we conclude that they choose the flat screens because of the better viewing quality.

7 Acknowledgements

The authors would like to thank UNISA's College of Science, Engineering and Technology for inviting them to be part of the summit. Special thanks to the mentors for a great time and learning experience.

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IRIS Functional Linked Learning

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Abstract – *The FIRST Lego League Competition (FLL) of 2014 focused on "Learning Unleashed" looking at "What is the Future of Learning". The teams were required to research ways in which learning can be improved in a creative way. The research of the IRIS (Intelligent Robotic Information System) Team (winners of the Project Innovative Solution Award at the North Gauteng Regional FLL competition) considered a way of learning related to the idea of a mind palace. This is based on the book by Joshua Foer, "Moonwalking with Einstein", where he uses means of association to memorize or remember work. Taking this further, a practical example of "Functional Linked Learning" was developed and discussed with learners, teachers and students.*

Keywords: Memorising, memory palace, functional linked learning

1 Introduction

According to the United Nations Universal Declaration of Human Rights, education is a basic human right [1]. However, education particularly at school has not always provided adequate or satisfactory education. Albert Einstein said, "Education is what remains after one has forgotten what one has learned in school" [2]. Using the twenty-first century idea of Joshua Foer, from his book "Moonwalking with Einstein", the IRIS team developed an idea based on memory palaces which relates to the theory of mind association or "mnemonics" [3]. This involved developing the theory of association in the teaching of subjects in a related or linked manner. In other words, the teaching of school subjects should be linked to a common theme so that learners can associate the various subjects with each other and thereby enhance and enlighten the learning process.

1.1 The idea of the Memory palace

In the book "Moonwalking with Einstein" Joshua Foer explains the method of remembering through association. He would visit friends' houses or public places and memorize the layout of these places. Then using methods of extreme concentration, for example, blackened out goggles and headphones, he would then imagine that he was walking through the house or place and 'drop' images or symbols in the different rooms, so that he could memorize the layout and therefore remember the information needed to be learnt [3].

2 The IRIS Solution to a Problem

As a team we first brainstormed all the ideas and possible solutions to our research topic "What is the Future of learning?" in this specific context. We then decided that the best way to study and remember a lot of information on different subjects is through linkage of the information through one theme. This we believe, in line with Foer, would enable the learner to study more easily. This model entails that all subjects can be learnt around one central and combining theme. We argue that this will improve the way of learning and hence the level of education in South Africa. It is believed that everything possible must be done to enhance the learning process in South Africa given that it is rated as having one of the worst standards of education in the world.

The prototype developed for this involved a model village representing clusters of different urban development: residences, factories, offices and places of religion. The village signifies a grade year's work, with the different blocks linked to a broad theme, such as for example wars.

Figure 1: The Village

In each block the different houses represent one aspect of this broader theme, for example World War I or the South African War or the Cold War. Finally, the rooms in one specific house – the World War I house - are focused on the different subjects taught – such as English, Mathematics, History, Geography, Technology, Art and Science.

Figure 2: The House

Each subject will use World War I as the central theme. So, besides a History room that obviously explains the origin and development of World War I the other rooms also relate the World War I theme. The English room deals with a famous World War I poet, Rupert Brooke, and so his writing is put in the broader context; the Science room deals with poisonous gases that were developed and used in World War I such as mustard gas and chlorine and "hot stuff", while the Technology looks at the development of the tank; the Geography room takes a look at the theatre of World War I and other strategic matters related to aspects such as distance, capitals, typographical and coordinates of the different countries involved; the Art room considers the various types of war Art that emerged during the War and how the War affected the artists; while the Mathematics room takes statistics from the War and makes various calculations, pie graphs and algebraic equations.

Figure 3: The History room

By linking the learning of the different school subjects to one central theme, learners benefit from not only the association, but also obtaining a more in-depth understanding of a particular theme. In other words, the learners see many aspects and understand various perspectives about one theme while getting to understand the different subjects without having to deal with different contexts.

Our aim is to also encourage the use of linked learning in schools as a method in order to teach the work making it easier for the work to be studied and remembered by the learner.

3 Literature and Research

Starting with the 2011 book by Joshua Foer, "Moonwalking with Einstein", we researched information related to mind palaces and the question of memory and the ways of training the brain to remember. This included articles on the web as well as reviews of Froer's book.

Once we came up with the idea of "Functional Linked Learning", we brainstormed ways of presenting this to learners. We then

discussed the idea with fellow learners, teachers as well as university students. Their comments and reactions further shaped and refined our ideas. The positive comments from university students in particular who reflected on their school years and said that they felt that Linked Learning would make more sense and facilitate better understanding. They felt their education had been about so many different themes, nothing really made sense as it was superficial and disconnected. They believed looking at a theme from different subjects with their different perspectives would be much better.

4 From Model to Virtual Development

The IRIS team intends to take the idea of Functional Linked Learning as set out in the physical model which has been well-received and develop it into a virtual format. This computer program could also be reconfigured as a computer application which should make it accessible to a wide range of users (the learners) at relatively low cost. Thus to maximize the information learnt, our team has come up with an idea of a computer program that enables you to experience the rooms virtually. The computer program is to make this process of linked learning easier whereby the physical village with its blocks, houses and rooms is made virtually, and where the setting may be adjusted to suit the needs of the learner. In order to do this, experts will have to be consulted so as to develop a prototype that will be accessible and affordable to address the dire education problems of the country.

5 Future Research

Further would need to be done on the effectiveness and appeal of the product among learners. This would need to be done along with the development of the possible computer version – with a virtual walk through a house and its rooms about a related topic.

6 Conclusions

The team believe that this method of linked learning will add to the learner experience. It is also hoped that it will add depth to the learning experience making it more exciting but at the same time empowering the learners as they receive a more rounded education and one they will hopefully find more interesting.

7 Acknowledgements

The authors would like to thank UNISA's College of Science, Engineering and Technology for inviting them to be part of the summit. Special thanks to the mentors for a great time and learning experience.

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How a Solar Car Converts Solar Energy to Mechanical Energy

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Abstract - *For many thousands of years the sun has shaped the lives of human beings, buildings, farming and forestry. The sun has also impacted on religious beliefs, cultures, social relations and lifestyles across the globe. Solar energy does not pollute the earth. There are different sources of energy that can drive a car which include ethanol, electricity and fossil fuels like petrol. Many people are asking whether solar is the fuel for the new millennium. The solar car project seeks to develop a car that does not use fossil fuel which means we will be travelling green. This research seeks to explain how in a solar car, solar panels convert solar energy to electrical. This electrical energy is then converted to mechanical energy.*

Keywords: solar energy, sun

1 Introduction

The sun is the star at the centre of the Solar System. It is almost perfectly spherical and consists of hot plasma interwoven with magnetic fields [5]. The earth receives 174 pentawatts of incoming solar radiation. Approximately 30% of this insolation is reflected back into space while the rest is absorbed by clouds, oceans and land masses. The spectrum is spread across visible and near infra-red ranges with a small part near ultra violet radiation. Solar energy is responsible for natural phenomena like thermal currents in air which leads to wind and ocean currents which leads to tides.

2 Aims and Objectives of the Research

This paper gives a brief background to solar energy and aims to explain how a solar car converts solar energy to mechanical energy. A brief literature review will be given and the components of the solar car will identified. An explanation of how they work will be discussed. The objectives are to explain:

- how solar energy is converted to electrical energy in the solar panel;
- how electrical energy is stored in fuel cells;
- how the electrical energy is converted to mechanical energy to drive the solar car; and
- the main components in a solar car.

3 Literature Review

A team of six learners carried out research. The research was done through a literature survey. The main source of information was through internet search. Each team member was given a section to research on and a summary of the findings are discussed in this section.

3.1 Non-renewable vs. renewable energy

Renewable energy is vital in today's world as non-renewable sources being used currently will get exhausted. Fossil fuels are non-renewable sources of energy which Hydrocarbons stored in fossil fuels release energy when they undergo combustion. An alternative solar energy is renewable and does not run out can only stop existing if the sun dies. The solar panels that are used to capture solar energy do not contribute to global warming, as it does not contaminate the air by releasing carbon dioxide or other pollutants. Unlike hydrocarbon fuel emits carbon dioxide into atmosphere which destroys the ozone layer leading to global warming climate change and natural disasters

3.2 History of solar cell

The first solar cell was built in 1883 by Charles Fritts, using junctions formed by coating selenium (a semiconductor) with an extremely thin layer of gold. However, the device was only about 1 percent efficient. Albert Einstein explained the photoelectric effect in 1905 for which he received the Nobel Prize in Physics in 1921. In 1941, the silicon solar cell was invented by Russell Ohl and in 1954, Pearson, Fuller and

Chapin, designed a silicon solar cell capable of six percent energy conversion efficiency. They are credited of creating the first solar panel.

3.3 Photovoltaic

Photovoltaic (PV) is a form of energy production that uses the sun's power to generate electricity. The sun's light, or solar radiation, is the fuel that provides energy in the form of photons. Semi-conductor materials such as silicon are the basic building blocks of photovoltaic cells. Electrons freed by the interaction of sunlight with semiconductor materials in the PV cells produce electricity. PV cells produce direct rather than alternating current (AC).

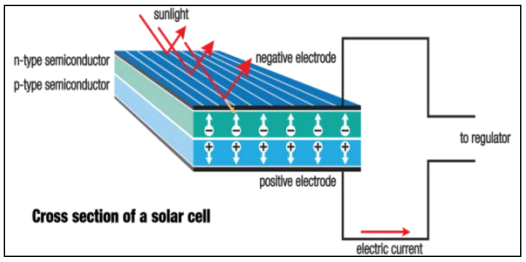


Figure 1: Solar cell
(Source: http://www.circuitstoday.com/thin-film-solar-cell)

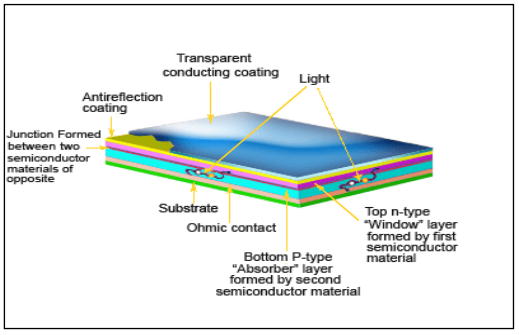
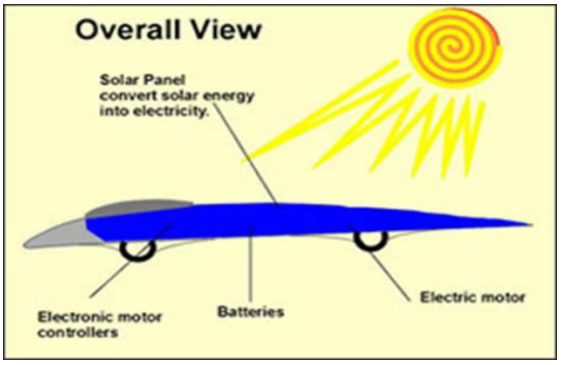


Figure 2:



Figrue 3: The solar car

3.4 Components of a solar car

Components of a solar car [2] include the following:

- Solar Array and Power Trackers: A solar array created from individual solar cells these covers the upper portion of the car.
- Batteries: The batteries store energy from the solar array and make them available for the motor's use. Nickel-cadmium batteries are used.
- Motor & Controller: DC brush permanent magnet motors can be used to drive their solar cars.
- Instrumentation: A state-of-charge meter gives information about system voltage, amp draw, battery energy remaining, and estimates the how much time remains until the battery is out of energy.

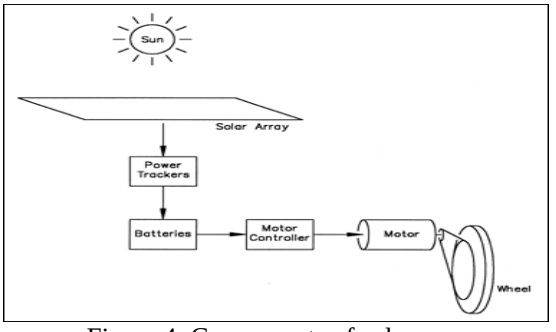


Figure 4: Components of solar car

3.5 Car performance

A solar car using efficient solar cells may go as fast as
70 km/h under direct sunlight alone, 120 km/h with help of the battery and 10 or 20 km/h under

cloud, rain, tunnel, or going uphill without the battery.

4 Conclusion

The solar car can solve many pollutions problems from transport by using free energy source. However the initial cost of solar cars is high. Solar energy is renewable energy is a lasting alternative for the future as fossil fuels will be exhausted at a certain point.

5 Acknowledgements

The authors would like to thank UNISA's College of Science, Engineering and Technology for inviting them to be part of the summit. Special thanks to the mentors for a great time and learning experience.

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Compare and Contrast the Different Forms of Renewable Energy to Solar Energy to Power Vehicles

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Abstract - *Crystallography is the scientific field of study where crystallization and the form/structure of crystals is investigated and considered. Renewable resources are natural resources which can be replenished with the passage of time, either through biological reproduction or other naturally recurring processes. In our research study we have noticed that our natural resources are being depleted and that society needs to conserve the available. We have concluded that it is much cheaper to use solar energy where vehicle + sun = solar vehicles is our working definition in this paper. Our study of solar energy helps to slow down global warming which contribute to climate change. Solar power has made a free ride possible but it can also have disadvantages.*

Keywords: renewable energy, solar energy, crystallography, solar vehicle, physics, climate change

1 Introduction

Climate change concerns are driving increasing growth in the renewable energy industries. Globally from our literature review it is estimated that three million direct jobs occur in renewable energy industries, where 50% occur in the biofuel industry. Our observations are that people will in the near future demand more resources such as fresh water, consumption of natural resources, etc. at a faster rate in future generations. Wind energy is the conversion of wind energy into a useful form of energy for example windmills for mechanical power. Biofuel energy is a description of potential energy contained in biofuel measured per unit mass of the fuel an example is bio-ethanol – which is alcohol created by fermentation. Geo-thermal energy is thermal energy stored and generated in the earth. Solar energy is the radiant light and heat from the sun harnessed using solar thermal energy and photosynthesis.

2 Problem Scope and Specifications

Wind energy uses wind turbine to make electrical power and biofuel uses biomass. Geo-thermal energy has been utilised for heating water. Solar is used for transforming heat into energy. Wind energy reduces operating cost and extends range. Biofuel is used by people in order to save money and decrease their consumption of fossil fuel. Solar power can save our resources in the future generation. Geo-thermal is environmentally friendly and does not cause pollution.

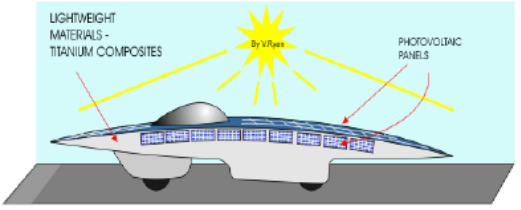

Figure 1: Schematic Illustration of Solar Vehicle [Source: http://www.technologystudent.com/energy1/solcar1.htm]

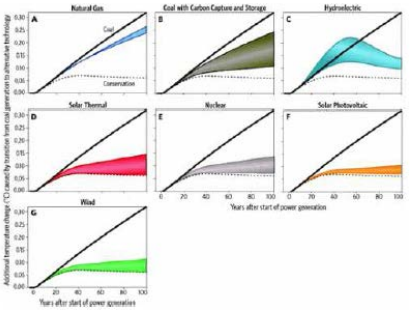

Figure 2: Comparison of global heating effect from transitions

of coal technologies to various alternative energy sources
[Source: http://cleantechnica.com/2013/10/08/advantagesdisadvantages-solar-power/]

Gas turbine is an example of internal combustion engine. Auto racing is a sport involving racing competitions, are just among specification needed.

Figure 3. Illustration of the Tokai Challenger which is a
solar car which won the 2009 World Solar Challenge
[Source: http://en.wikipedia.org/wiki/Solar_car]

As there are photovoltaic cells in solar vehicles they may cause limitations:

- Power density: Power array is limited by the size of the vehicle and area that can be exposed to sunlight
- Costs: Although sunlight is free, creation of PV cells to capture sunlight is expensive
- Design considerations: PV cells have lifespans and even though sunlight does not have. PV cells lifespan of approximately 30 years

And if maybe it rains the whole month, PV cells won't be charged.

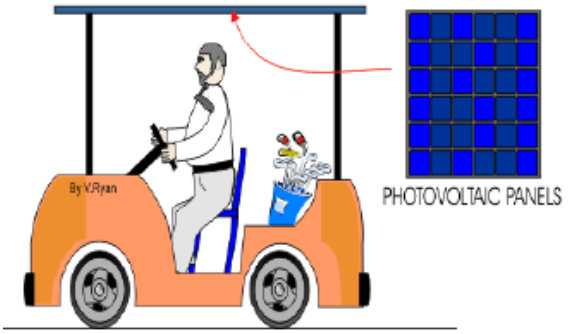

Figure 4. Illustration of a solar car using overhead
photovoltaic panels
[Source: http://www.technologystudent.com/energy_solcar.htm]

3 Literature Review

The crystals are namely:
Solar cells – made from monocrystalline silicon wafer
Polycrystalline silicon: consists of crystallites (a small crystal)
Photovoltaic systems: also called a solar array, supplying solar power by photovoltaic.

Ultraviolet: electromagnetic radiation with a wavelength etc.

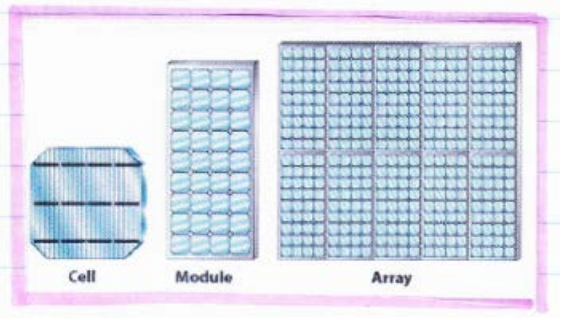

Figure 5. [Source: http://www.energtech.com/Information]

- PV panels provide clean energy
- Solar panels cost is currently on a fast reducing track
- PV panels produce electricity directly using photoelectric phenomenon
- PV panels operating and maintenance cost are very low
- PV panels compared to an engine is silent

- PV panels have no mechanically moving parts except of sun tracking mechanical bases
- An attractive investment alternative
- Easy to install on rooftops without any interference to residential lifestyle
- Has indeed a highly promising future.

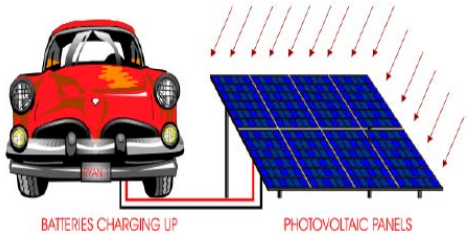

Figure 5. Illustration of the principle of how batteries are
charged from photovoltaic panels
[Source:
http://www.technologystudent.com/energy1/solcar.htm]

PV panel will produce between 700-900 units [KWh per year of electricity]. When it is shining it is 1000 W/m2 but less when it is cloudy. PV produces much more energy in summer than winter. To know how much electricity you can produce, use PV GIS tool or a Solar Calculator.

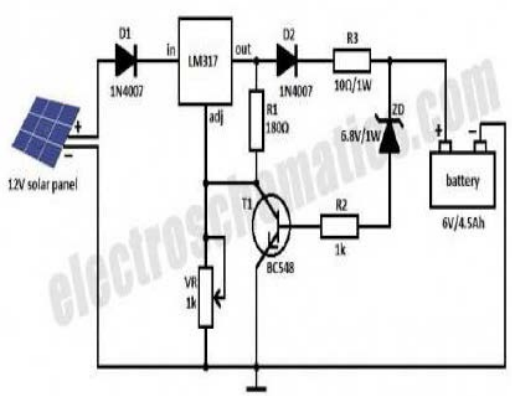

Figure 6. Illustration of a solar charger with current regulation
and cut off circuit
[Source:
http://www.electroschematics.com/4746/solarcharger-circuit/]

4 Problem Solution Options

Wind energy: the necessary systems needed to convert are mechanical rotation into electrical power. Uses wind turbines installed at a strategic point of the vehicle. The wind power is converted into mechanical energy which moves the car.

Solar energy: uses photovoltaic cells made up of semiconductors made of silicon that absorb the light. Capture energy from the sun converting it to electricity. It then fuels the batteries that run the car's motor. Instead of a battery, an electric motor can be used. This is accomplished through using photovoltaic cells [PVC]

Biofuel energy: It is captured by biomass and it is converted to convenient energy containing substances in 3 ways, namely:

- Thermal conversion
- Chemical conversion
- Biochemical conversion

Wind energy: A wind turbine used for charging batteries is wind charger. The wind turbine converts kinetic energy from the wind into electrical power. Solar energy: Energy from the sun converted to thermal or electrical energy

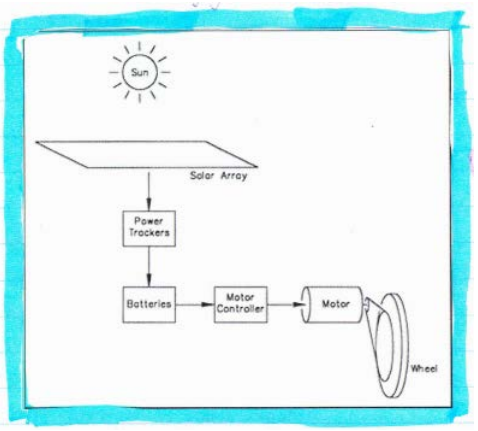

Figure 7. Illustration of the physical processes of how solar
energy is used to power a solar car
[Source: http://www.electroschematics.coms]

5 Research Findings

Wind Energy: Wind turbines have a role to play in both the developed and third world. The strength is not constant and it varies from zero to storm force.

Solar Energy: Remains popular because it is both a renewal and clean source of energy. Disadvantages: Final Consideration it can be harnessed only during sunny days and day Time.

Biofuel Energy: Cost – less expensive than gasoline

Energy output – has a lower energy output than traditional Fuels. The most useful energy forms are:

- Tidal Power
- Wave Power
- Solar Power
- Wind Power
- Hydroelectricity

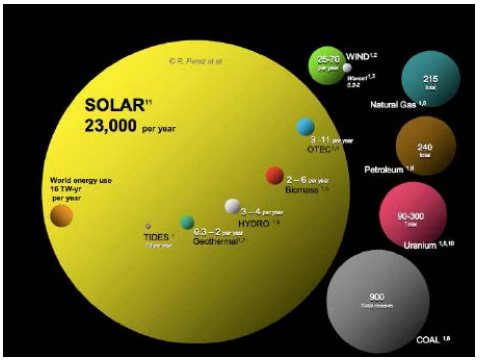

Figure 8. Illustration of potential renewable energy resources versus the total known recoverable reserves of non-renewable energy resources
[Source: http://cleantechnica.com/2013/10/08/advantagesdisadvantages- solar-power/]

6 Conclusions

We compared and contrast the different forms of renewable resources. We did compare the different resources and we according to statics the solar energy is discovered to be able to:

- Slow/stop global warming
- Save society billion or trillions of dollars
- Save you money
- Provides energy reliability
- Provided energy security
- Provides energy independence
- Creates jobs

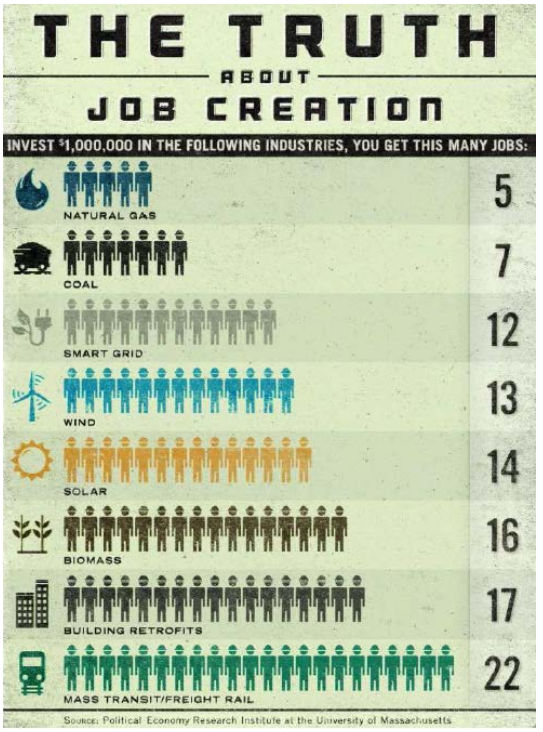

Figure 9. Illustration of potential job creation opportunities
from different forms of renewable energy resources
[Source: Political Economy Research Institute at the
University of Massachusetts]

7 Acknowledgements

Willowmead Secondary School would like to acknowledge the following people for the assistance during the research project. Thanks to UNISA for inviting us to the Science theme this year "CRYSTALLOGRAPHY". We would lie to thank Mr Selemo for choosing the whole school, Mr Zishani for accompanying us to the BMW Rosslyn Plant. We further thank Mr Ramnath for giving us some background on our research.

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Photographs of Teams

Learners team

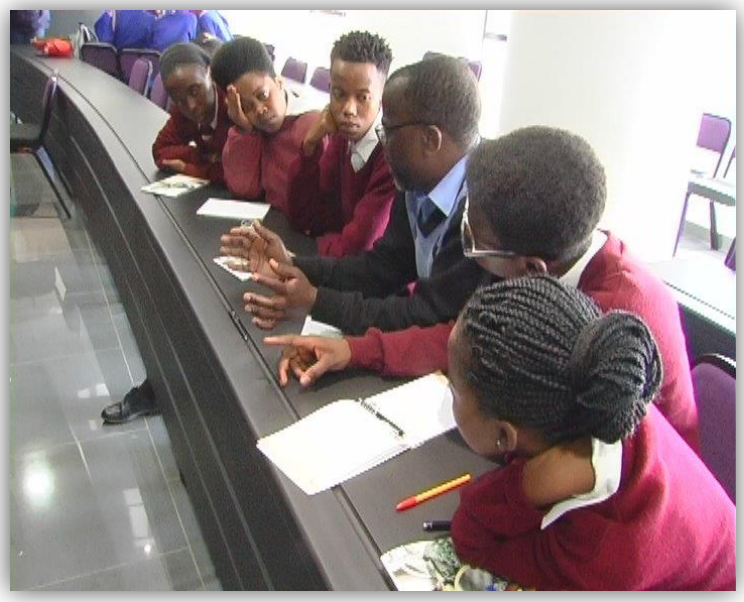
Learners team

Learners team

Learners team

Learners team

Learners team



Learners team

Learners team

Executive Dean of the College of Science, Engineering and Technology

Speaker

Speaker

Speaker

Speaker

CSET staff in attendance

Cross section of the learners attending LRS workshop

Cross section of the learners attending the LRS