

## Carbon Footprint Calculator for Children

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### Abstract

Climate change is an environmental problem that is identified as a global issue which is closely linked with carbon dioxide emission. There are various ways to reduce the amount of CO<sub>2</sub> emission. One of them is by increasing the knowledge among people especially youngsters who have less exposure about climate change. This paper investigates the effectiveness of using a medium which is an interactive web based carbon footprint calculator for kids called CFCKids. CFCKids is developed to allow children to calculate their carbon footprint based on their daily activities that contribute to the emission of carbon dioxide (CO<sub>2</sub>) for educational purposes. The calculation is divided into three parts which are home, school and tuition. CFCKids also provides information about climate change and tips to reduce carbon footprint. In testing phase, the pre and post-test on its usability and content had been conducted with children age ten to twelve years old. From the findings, it is discovered that CFCKids can increase the knowledge of children about climate change and how they can naturalize from the result of their carbon footprint calculation. This project is also relevant in becoming one of the educational mediums for them. For the future works of CFCKids, the system will be enhanced to allow children to connect with their friends using CFCKidsapplication which allows them to share their carbon footprint report to create awareness by looking into the impact of their own carbon footprint which can lead them to be more responsible towards the environment.

*Keywords* : climate change, carbon footprint calculator, design principle guideline for children.

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### 1.0 Introduction

Climate change is a global issue that will affect human life (Kadarudin et al. 2008). All parts around the world will affect by the risk of climate change phenomenal. Base on the report by The National Oceanic and Atmospheric Administration (2007), the warmest period was recorded between the end of 20th and the beginning of the 21st century. If this situation continuously occurs, it will risk human life. The increasing of earth's temperature will destroy the variety of life on earth, which is call as biodiversity. Carbon dioxide is the most significant greenhouse gases generate by human (Starazdins& Skeat, 2011). Excessive of CO<sub>2</sub> will trap heat in the atmosphere that will lead to greenhouse effect and the earth's surface temperature will also be increased.

Climate change is a global issue. Therefore, Malaysia has made an initiative where we committed to reduce our carbon footprint, by reducing 40 per cent emission of CO<sub>2</sub> by the year 2020 which can be compared with the 2005 level (Cheng, 2013). The Prime Minister of Malaysia, DatukSeriMohdNajib (2013) also had mentioned the importance of reducing carbon footprint where he encouraged all citizens to be part of it. To achieve the country mission, all of us must take part to reduce and to naturalize our carbon footprint. Thus, the statement has become the motivation in carrying out this project as one of the effort to response to the climate change issue in looking into creating awareness among Malaysian. Carbon footprint is a measure of carbon dioxide (CO<sub>2</sub>) that is based on total amount emission associates with an activity (Wiedmann& Minx, 2008). In this paper, activities are relate to all action that involve in the area of children's education age range 10-12 such as at school, tuition and at home would be calculated.

Children are a group that mostly affected by climate change risk such as environmental health hazard (Strazdins& Skeat, 2011). So, it is very important to expose and create awareness at a young age. Currently, there are many mediums and platform that have been used to deliver information about climate change such as newspaper, television, social media, radio and others. But, by using only this medium to deliver the information, there will be a group that fall behind and not getting the information especially children. Sometimes, the word or terms that were used is difficult to be understood by them. To increase the awareness and educate them about climate change, a specific approach can be taken to make sure that they will get the right information and increase their knowledge about climate change.

The focus of this project is to develop an interactive web application to calculate carbon footprint that is convenience and easy to be understood by children. This application was designed for children age range 10 to 12 years old. However, this application could also be used by students in a secondary school because it covers the daily education aspect. This application was developed to calculate children's carbon footprint base on their daily education activity that contribute to the emission of carbon dioxide (CO<sub>2</sub>). The application also allow user to print out the report of their carbon footprint. The principle of Children Computer Interaction (CCI) was used as the design guideline for children in education in the development of this project prototype.

## **2.0 Related work**

The significant of this research is to educate people especially children about climate change issues and make them becoming more knowledgeable in environmental protection. In order to crete children's awareness a web application is developed as a medium in showing them in a more attractive and appealing to attract their attention on such a complex issue so that they are able to see the impact of their lifestyle on the environment by calculating their own carbon footprint. This paper will also benefit each individual who wants to know about carbon footprint, and it will beneficial to a group of student that can use this study as one of the resources.

### **2.1 Carbon footprint**

Carbon footprint is a measure of carbon dioxide (CO<sub>2</sub>) base on total amount emission which is associates with an activity (Wiedmann& Minx, 2008). In United Kingdom, a demand of carbon footprint calculator over the past few years is increasing due to climate change issue. In Malaysia carbon footprint calculator is still new. In year 2011, Forest Research Institute Malaysia (FRIM) is one of the organizationthat calculate its annual carbon footprint, with the aim to eliminate the waste of energy and reduce operational cost (FRIM, 2012). This is supported by Fredolin (2012) where research in climate change in science and surrounding region still has a wide gap (Fredolin et al., 2012).

Carbon footprint is appropriate and necessary for current situation because almost all human activities contribute to emission of carbon dioxide. Without carbon footprint calculation, people will not know the impact that it can contribute to the environment that leads to the risk of climate change (Abbott, 2008).

### **2.2 Carbon Footprint Calculator**

A carbon calculator was closely link with carbon footprint. Hunter and Waters (2009), define that a carbon calculator estimates carbon footprint. They also agree that carbon footprint calculator measures the emission of greenhouse gases to determine the amount or quantity of greenhouse gases that was produced for a specified year.Each country has a different amount of emission factor and the emission factor may change. The average efficiency for specific power plants (conservative method) was use as a determinant for formula to calculate CO<sub>2</sub> emission (Greentech, 2013).

According to Clark (2012), there are many existing carbon calculator and evolving standards for calculating carbon footprints, but he agreed that there are no precise in calculating carbon footprint. However, the result for the calculating using different web site can vary widely different depending on the formula that they used (Clark, 2012).

In this project, carbon calculator formula is adapted from Green Campus Initiative (GCI), a project done by UCSI University in showing their commitment in reducing the risk of climate change (Keoy et al., 2011) as shown in Table 1. Diagramin Figure 1 shows the factors that contribute to the calculation of carbon emission based on daily education activity of children for electricity, fuel, paper, plastic, bottle and can which is applied in CFCkids application.

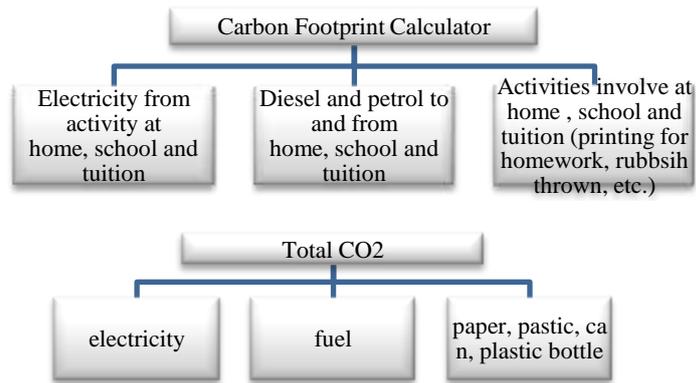


Figure 1: Carbon Footprint Calculation

Table 1: Carbon Footprint Formula Adopted from UCSI University (Keoy et al., 2011).

Variables	Carbon Footprint Formula	Notes
Electricity	$CO_2 = AME * EEF$ <ul style="list-style-type: none"> <li>AME : Average Monthly Electricity used (kWh)</li> <li>EEF : Electricity Emission Factor (CO<sub>2</sub>e/kWh)</li> </ul>	It is better to use the average EEF of West Malaysia 0.585 CO <sub>2</sub> e/mWh
Fuel	$CO_2 = AMF * FEF$ <ul style="list-style-type: none"> <li>AMF : Average monthly Fuel used (Liters)</li> <li>FEF : Fuel Emission Factor (CO<sub>2</sub>e/Kg)</li> </ul>	<ul style="list-style-type: none"> <li>Every liter of gasoline releases 2.5 Kg of CO<sub>2</sub></li> <li>Every liter of diesel releases 2.85 kg of CO<sub>2</sub></li> </ul>
Paper	$CO_2 = AMP * PEF$ <ul style="list-style-type: none"> <li>AMP : Average Monthly Paper used (Kg)</li> <li>PEF : Paper Emission Factor (CO<sub>2</sub>e/Kg)</li> </ul>	<ul style="list-style-type: none"> <li>1 Kg of virgin paper produces 3.24 Kg of CO<sub>2</sub></li> <li>1 Kg of recycle paper produces 1.76 Kg of CO<sub>2</sub></li> <li>The weight of one A4 standard paper is 5 gram.</li> </ul>

#### 4.0 Findings

The interface for CFCKids was constructed base on design principle guideline for children. The interactive web of CFCKids application was designed and developed by applying images and animation and less text to cater the needs of children who has less interest to learn about a complex issue such as climate change. Figure 2 shows the main page of CFCKids web application.



Figure 2: Main Page for CFCKids

After all necessary information have been included, the result page of carbon footprint will appear after user click “Result” button. In this page it will display the total amount of carbon footprint base on kids’ daily activity on education purpose that contributes to the emission of carbon dioxide. Besides that, user can also view the total amount or carbon footprint weekly and monthly (Figure 3).



Figure 3: Result Page

A post-test evaluation had been conducted by distributing questionnaire to fifteen respondents age range 10-12 years old. Participants evaluated the web application after they themselves experience the CFCKids' application. Several questions were asked to measure their understanding regarding climate change issue and how the carbon footprint calculator managed to increase their understanding and what how the result of their carbon footprint calculation affects their daily life.

#### 4.1 Awareness about Climate Change

Most of the participants have shown improvement on basic knowledge about climate change issues with 50% increment compared to before they use the CFCKids application. However, there are 17% respondent that still did not get the idea or even after they used CFCKids application. One of the respondent said that he read all the content about climate change in the CFCKids but he does not really understand it because the words and sentence is difficult for him to understand. However 83% of respondent find that the content of the climate change is easy to be understood. This differences may occur due to participants reading skill and language.

#### 4.2 Carbon Dioxide Emissions and Carbon Footprint

The evaluation results show that 58% of respondent claimed that they knew about how CO<sub>2</sub> is produced after they used CFCKids. From this finding, it shows that the information of CO<sub>2</sub> that is provided in CFCKids managed to increase the understanding of the children. This is important due to proper knowledge about CO<sub>2</sub>, it is easy for them to figure out about their carbon footprint calculation result.

It is interesting to know that after the calculation is being made, 83% of participants agree that they are eager to see on how their daily activities contribute to carbon dioxide emission. Others still could not figure out the purpose of the calculation results. This may happened due to the lack of explanation about carbon footprint in CFCKids. In CFCKids, there is not much information that provide a detail explain about carbon footprint compared to climate change, greenhouse and carbon dioxide.

The consequence of this project has managed to create awareness to most of the children that participates. The feedback that is gain is invaluable where participants stated that it is important to protect the environment because every action that they take can contribute to carbon emissions that lead to climate change. A fruitful discussion has also been made by researcher and participants where a complex issue such as this is actually very new and vague to them, a lot of questions were asked, and finally researcher manage to leave participants on a knowledge that they have ignore before.

#### 5.0. Conclusion

CFCKids is a web base application that functions as a medium to educate people especially children about climate change. The main objective of this study is to evaluate the effectiveness of carbon footprint calculator on children. The strength of CFCKids is on carbon footprint calculator which allow user to calculate their carbon footprint. The challenging part in this research is to get the formula of carbon footprint base on Malaysia scenario. Even though there are many carbon footprint calculators that were available in the Internet. CFCKids is developed for children in Malaysia, which highlights the carbon emission base on children daily activity on education purpose. It is recommended that this project can be enhanced by adding other features such as game, chatting room that allow

children to communicate and discuss their carbon footprint result and also allow for interface customization.

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