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TRAVEL BEHAVIOUR MODIFICATION TECHNIQUE – A FRAMEWORK FOR AWARENESS ON CARBON FOOTPRINT TOWARDS ADOLESCENTS IN DEVELOPING COUNTRY

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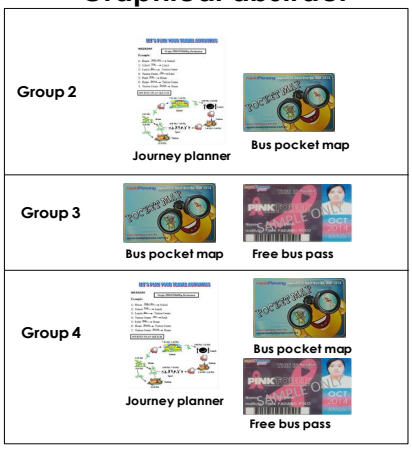
Graphical abstract



Abstract

Travel behaviour modification (TBM) techniques have been successfully implemented in many developed countries to reduce the negative impact of motorization and to increase the usage of more sustainable modes of transport. However, very little has been reported with regard to their effectiveness in developing countries. This paper emphasizes the framework of TBM techniques that might be implemented in developing countries by focusing on secondary school students as the main respondents. The recruited students were divided into four groups based on the assigned intervention approaches such as a control group (Group 1), journey planning group (Group 2), incentive group (Group 3), and journey planning with incentive group (Group 4). The main instruments for this study were travel diaries that were used to record the students' daily travel activities and individual carbon footprint. The questionnaire survey was used to measure the pro-environmental awareness of the students. A few hypotheses in relation to the experiment on TBM techniques were also highlighted in this paper.

Keywords: Travel behaviour modification technique, sustainable transport, carbon footprint

1.0 INTRODUCTION

Private motorized vehicles have become a dominant and important mode of transport in most cities in the world over the last few decades. The research also shows that not only adults but also the adolescents and younger peoples nowadays were more preferred to travel by using private transport due to its attractiveness and advantages, which surpass those of other modes of transportation [1]. In Malaysia, the demand for private vehicle ownership has increased significantly with escalating trends in the accumulated number of registered drivers each year. This situation not only worsens the traffic problems on urban road networks but also has a negative impact on the society, the economy and the environment. The transportation sector was reported to contribute 14% of the total global greenhouse gas (GHG) emissions, and 76% of that proportion was attributed to the road transport sector [2]. Besides that, the transportation sector in Malaysia recorded the largest energy consumption, accounting for 37% of the total in 2012 [3]. This sector depends greatly on petroleum products, which are the main contributors of carbon dioxide (CO_2) emissions [4]. Consequently, the concept of Carbon Footprint (CF) has been introduced in a few studies to measure the impact of human activities on GHG emissions by considering all the relevant sources of both the consumption and production of GHG in units of carbon dioxide equivalents (CO_2-e) [5]. Travel Demand Management (TDM) in transportation studies is aimed at solving not only the problem of congestion but also transportation problems that have to do with carbon emissions.

Previous study stated that Travel Demand Management strategies are divided into two

categories, namely hard and soft transport policy measures [6]. Various conventional hard measures, such as penalties and road pricings were claimed to be difficult to implement as they were less acceptable to the public. In addition, they were also politically unfeasible and may not be adequate enough to be depended on totally [7, 8]. Then, the idea of offering soft measures was introduced to overcome the weaknesses of the hard policy [9]. One example of soft measures is the travel behaviour modification (TBM) techniques. The goal of these techniques is not only to solve environmental or health problems, but also to provide road users with the psychological motivation (instead of punishment) to voluntarily be involved with sustainable travel behaviour [10]. The TBM techniques have been investigated quite extensively in developed countries such as Europe, Australia, and Japan under various programs, for example, Individualised Marketing (IndiMark) [11], Travel Smart, Travel Blending [9], psychological and behavioural strategies [12], personalised travel plan (PTP) [13], travel feedback programs (TFPs) [14], and voluntary change measures [7]. Various TBM intervention techniques, consisting of persuasive communication by providing specific travel and feedback information, formation of individual behavioural plans, and offering incentives have been used from previous studies [14-17]. Therefore, it is important to understand the intervention strategies of TBM since the effectiveness of this approach depends on the types of techniques used, either by focusing on one technique or using a combination of techniques.

Because of the lack of studies regarding travel behaviour modification techniques in developing countries, this paper attempts to develop a framework for a TBM technique to be introduced in Malaysia by taking students at several schools in Penang Island as examples of focus groups. The structure of the framework for this study was constructed based on the large number literature reviews on successful travel behaviour modification programs in developed countries. Secondary school students were selected as the respondents for this study because their travel patterns are easier to comprehend, since their main trips daily will involve going to school and returning home. Furthermore, it is much easier to encourage them to use bus as an option to reduce the usage of private motorized vehicles. However this paper will only presenting the framework of the TBM techniques the structure of the methodology and several hypotheses regarding the experiments that also can be implemented in other developing countries.

2.0 THE EXPERIMENTAL GROUPS

In order to examine the suitability of TBM techniques in Malaysia, a special program was established that focusing on the secondary school students. The program, supported by Rapid Penang (Prasarana Sdn. Bhd.), was called 'Jom Reduce Carbon Footprint'. Eight schools in Penang Island were identified as being suitable for this program because of their accessibility to the bus services and the existence of the pedestrian walkways. Out of a total of 200 students who were recruited from these schools, 184 of them agreed to commit themselves until the end of the program. They were assigned as the representatives of this program and were encouraged to use the Rapid Penang buses throughout the program.

The experiments on the TBM techniques began with three phases that had to be attended by the students. These consisted of the introductory phase, the intervention phase, and the feedback phase. Initially, the students were assigned to four intervention groups comprising a control group (Group 1), journey planning group (Group 2), incentive group (Group 3), and journey planning with incentive group (Group 4). The respondents in all the groups were given a program kit, in which was enclosed an information brochure about the impact of carbon footprint, with some tips on how to reduce it, a questionnaire survey, a travel journal, and some motivational gifts such as a plastic hand fan and button badge, as shown in Figure 1.

However, Group 2, 3 and 4 were given additional materials, as illustrated in Figure 2. For the journey planning group (Group 2), the respondents were asked to plan their trips for 7 days in sheets of paper. The objective of the journey plan was to reduce their dependency on motorized vehicle. In other words, this group needed to alter their travel pattern to be more pro-environmental. In addition, bus pocket map was also provided in their experimental kit. For Group 3, the respondents in this group had received free bus tickets for a month and also bus pocket map as their motivation to use the bus. Meanwhile, the students in Group 4 were asked to fill in their journey planner and also received free bus tickets for a month together with bus pocket map. Table 1 shows the characteristics of the students and the participated schools in this program.

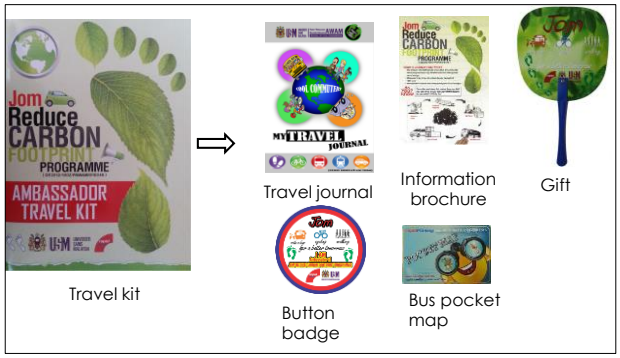


Figure 1 Materials that included in the travel kit (folder file)

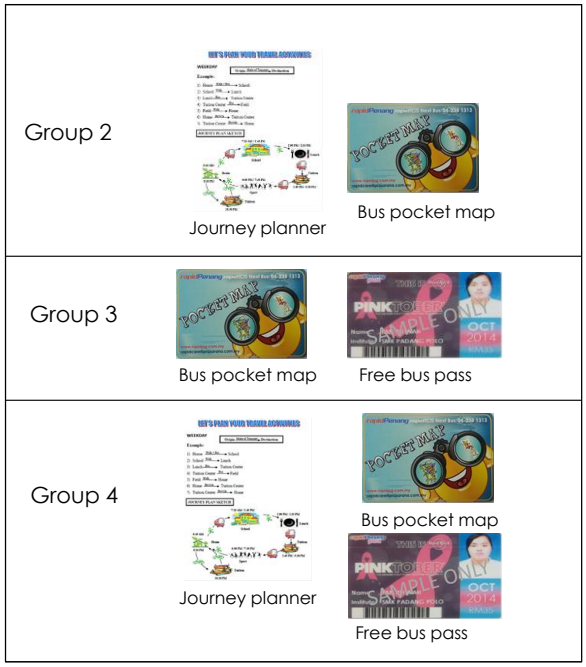


Figure 2 Additional materials for Groups 2, 3 and 4

Table 1 Schools involved in the 'Jom Reduce Carbon Footprint' program

Group	Name of participating schools	Male	Female	Total
1	SMK Pondok Upeh	9	16	25
	SMJK(C) Sacred Heart	9	13	22
2	SMK Air Itam	10	11	21
	SMK Raja Tun Uda	4	20	24
3	SMK Padang Polo	0	25	25
	SMK Sungai Ara	4	19	23
4	SMK Abdullah Munshi	2	20	22
	SMK Penang Free	16	6	22

3.0 FRAMEWORK OF THE TBM TECHNIQUE

The framework of this experiment was demonstrated in Figure 3. After the grouping stages completed, all the students were asked to answer the questionnaire survey. The questionnaire survey was designed and improved based on the results obtained in the pilot study [18]. In this framework, the questionnaire surveys were divided into two stages. The first survey was conducted before the implementation of the intervention techniques. The questionnaire surveys were aimed to gain information on the participants' socio-demographic attributes, household characteristics, mode choice for school commuting, psychological measurements on carbon footprint awareness, moral obligation towards environmental problems, and other psychological variables.

After the first survey, all students were given a lecture session on the environmental issues of transportation. Then, a short briefing was held to introduce and guide the students on how to fill in the travel journal for 7 days (including the weekends). The students were asked to report each characteristic of their daily trips including the purpose of the trips, origin and destination of the trips, travel distance and their mode of transport for the trips. After 7 days, they were required to return their travel journal and the individuals' carbon footprints for each student were then calculated by the researchers. In the second meeting, the participants received feedback on their 7 days carbon footprint. Equations (1) and (2) below show the calculation of distanced-based method that had been used to calculate the students' carbon footprint based on GHG Protocol guidance [19].

$$CO_2 \text{ Emission} = \Sigma \text{ Distance}_j \times d_j \quad (1)$$

$$d = b \times f \quad (2)$$

where d is the distance-based emission factors (kg/100 km), j is the different modes of transportation, b is the fuel efficiency (litre/100 km), and f is the fuel-based emission factors (kg CO_2/litre).

In the second meeting, a motivation session was also given regarding the impact of transportation problems on the environment to increase the students' awareness of global warming and climate change. Also, in this session, alternative travel patterns or lifestyle towards sustainable travel behaviour were suggested. The participants were then instructed to reconsider their dependence on cars and motorcycles, and were encouraged to use bus or active modes such as walking and cycling.

The students in Group 2 were asked to plan their daily trips for the next 7 days on the additional sheets that had been provided by considering reducing their usage of cars and motorcycles. During the planning session, they were asked to refer to the Journey Planner provided by Rapid Penang on its website. The Journey Planner provides details on the bus routes and suggestions on which bus should be taken to get to the destinations in Penang. Each participant in Group 3 was given free bus tickets for unlimited travel on Rapid Penang buses for a month. Meanwhile, the students in Group 4 also had to plan their trips just like those in Group 2, and they also received free bus tickets like the students in Group 3. The participants in Group 1 did not receive any intervention other than the motivational session.

After the all interventions techniques were carried out, each respondent were required to report again their trip patterns for the next 7 days in their Travel Journal 2. After all the Travel Journals 2 had been returned and the individual carbon footprints in them had been calculated, the participants were gathered once again for the final phase of the program. The feedback on the carbon footprints before and after the intervention were compared and distributed to the participants.

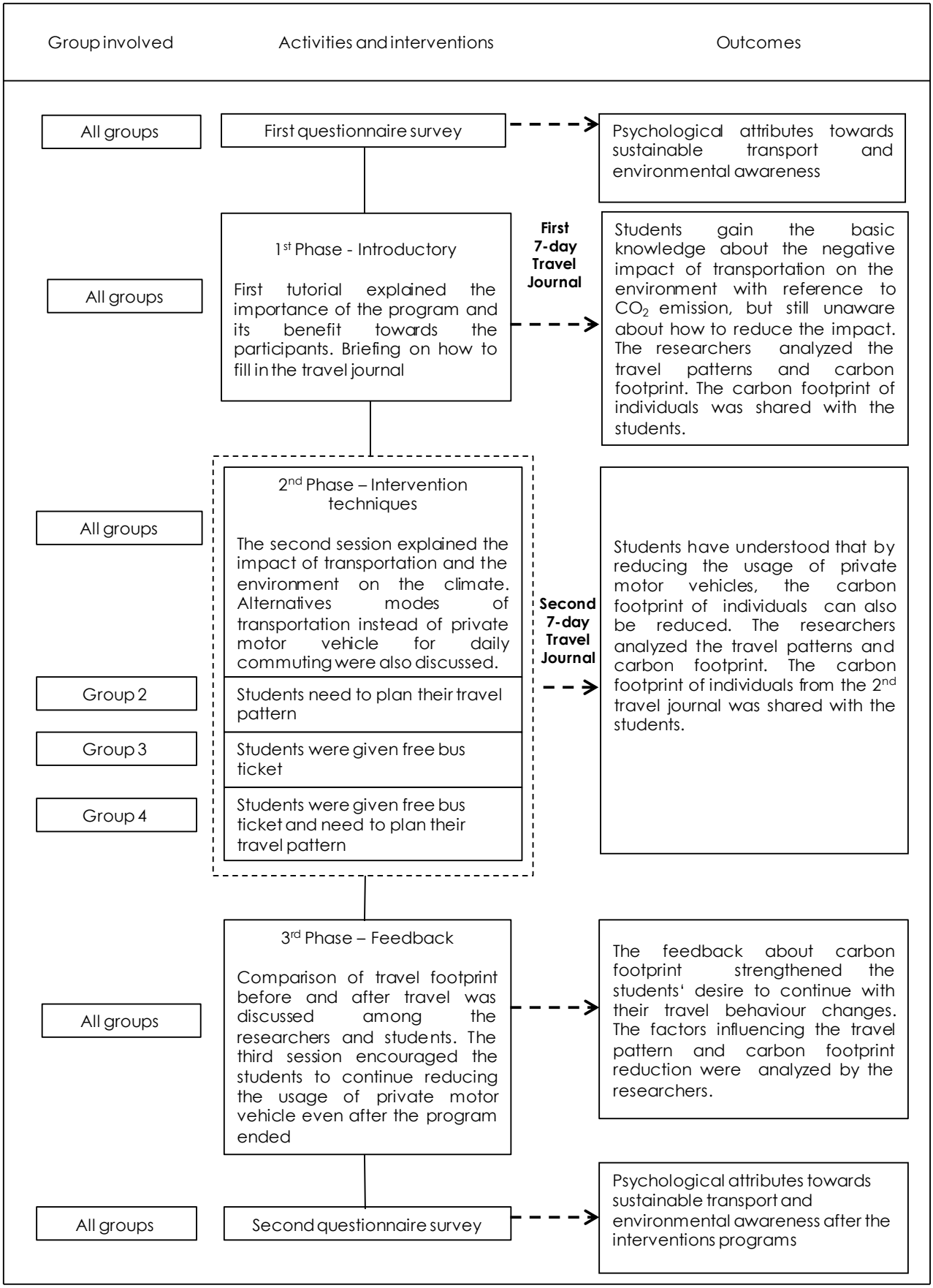


Figure 3 The framework of travel behaviour modification technique for school students

The second questionnaire that had similar attributes with the first questionnaire survey was then distributed. The objective of the two stages of questionnaire survey is to make a comparison on the effect of before and after the implementation of the TBM techniques to the students 'psychology and awareness towards carbon footprint. Before the program ended, the students were persuaded to continue with what they had learned in the program, which was to choose the mode of transport that produced a lower carbon footprint.

4.0 HYPOTHESES

Due to a less efficient public transport system, it has been claimed that TBM techniques can hardly be implemented in developing countries, including Malaysia. However, from the experimental program conducted in Penang Island, it is strongly believed that the TBM techniques can possibly be used to establish policies in relation to a sustainable transport system in Malaysia. There are several hypotheses regarding the suitability of the TBM techniques that have been experimented with in this study to be put into practice in Malaysia as listed below:

i. First hypothesis: There will be a significant difference in terms of individual travel patterns and carbon footprint before and after the implementation of the TBM techniques.
ii. Second hypothesis: The intervention for Group 4, that combines the journey planning with the incentive, will show the highest reduction of the individual carbon footprint compared to the other interventions.
iii. Third hypothesis: There is a significant difference in the psychological attributes before and after the implementation.

5.0 CONCLUSION

This paper emphasized the framework for measuring the effectiveness of TBM techniques and the possibility of implementing these techniques in developing countries. The main objective of the experiment was to determine the most suitable technique to be used for Malaysia and maybe for other developing countries by focusing on school students as the respondents. This is because the travel patterns of school students are homogenous and easy to understand. Based on the experimental hypotheses, it is believed that the TBM techniques can be implemented in order to encourage the school students to use public buses. However, motivational strategies, such as providing free bus passes for a certain period, providing an efficient information system, free access to Wi-Fi, and more convenient accessibility to bus stops, might need to be considered by bus companies. It is also believed that the TBM techniques cannot constitute a successful transformation program for the transportation system if there is inadequate support from the government, private authorities and related bodies in terms of political and financial support. However, the authors are strongly believed that if the TBM techniques could be implemented in Malaysia, the environment of transportation system will be changed to more sustainable system.

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