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SUSTAINABLE DEVELOPMENT GOAL 2: EXPLORING BANDURA'S TRIADIC MODEL FOR BEHAVIOURAL CHANGE AMONG URBAN PRIMARY SCHOOL STUDENTS.

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ABSTRACT

The average Malaysian disposes of 15,000 tonnes of food waste per day, out of which 6,000 tonnes is avoidable waste that could feed the poor. This study aims to address food security issues (SDG 2) in Malaysia by using Bandura's Triadic Model of Reciprocal Determination to examine food wastage behaviours among urban post-millennials. Food waste, which comprises spoilage, preparation waste, and plate waste, is common in schools; as such, qualitative interviews were conducted with 25 urban primary school students in Klang Valley, Malaysia. The findings revealed the interplay between students' personal factors, physical environment factors, and social environment factors in influencing their food wastage behaviours and perspectives. Additionally, it was observed that behavioural changes towards zero-food waste within the school community require environmental interventions, as urban school-goers lack knowledge of food storage alternatives, while their surrounding environment does not support broader food security concerns. Based on the findings, this study proposed a modified triadic model which incorporates permaculture as a sustainable practice in urban schools in Malaysia. Permaculture can act as an environmental stimulus that cultivates students' positive personal attitudes and feelings towards reducing food waste. Subsequently, there would be a reduction in food waste behaviour within the students' existing ecosystem. This study promotes the reduction of food waste in urban schools and contributes towards formulating a framework for food security in schools.

Keywords: post-millennials, cradle-to-cradle, food security, Reciprocal Determination, food waste, responsible consumption, food loss, Generation Z.

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1. INTRODUCTION

With the global population estimated to reach 8.6 billion people by 2030 (United Nations, 2017), the race is on to ensure that the world has enough food to sustain its growing residents. Accordingly, food security is a key part of the United Nations' Sustainable Development Goals, or SDGs (United Nations, 2015). SDG 2, in particular, champions the need to achieve food security and promote sustainable agriculture practices (Rosa, 2017). Despite ongoing efforts in this regard, it is estimated that humans waste one of every three food calories produced (Pearson et al., 2018). In Malaysia, the Solid Waste Management and Public Cleansing Corporation (SWCorp) reported that Malaysians throw away 16,688 tonnes of food daily (Sharif, 2018), amounting to 40 per cent of the total municipal solid waste (MSW) in the country (Jarjusey & Chamhuri, 2018). This figure is sufficient to feed 12 million people a day.

Food waste comprises preparation waste, customer plate waste, spoilage, avoidable or edible waste, and non-avoidable waste (Ong et al., 2019). Although authors argue that food waste occurs at any point of the food supply chain (Lemaire & Limbourg, 2019; Parfit et al., 2010), it is most readily defined as an occurrence at the retail and consumer stages (Parfit et al., 2010), with waste at the consumer level being the highest (Jarjusey & Chamhuri, 2018). The environmental implications of food waste are monumental, including an increasing demand for substantial amounts of water, energy, and large land areas for production (Swaffield et al., 2018). Consequently, two questions arise from this phenomenon. First, what are the reasons behind individuals' environmentally and socially damaging behaviour? Second, what should researchers know to introduce change interventions to reduce food waste?

Studies have shown that post-millennials or Generation Z are on track to be the most diverse and best-educated generation (Dimock, 2019). Born between 1997 and 2012 (Dimock, 2019; Fry & Parker, 2018), these individuals were raised in a technological environment and are 'Always On', marking dramatic shifts in their attitude, cognition, and behaviour compared to previous generations (Dimock, 2019). Malaysia is home to 9.4 million post-millennials, with individuals between the age of six and 18 making up approximately 29 per cent of the national population (Department of Statistics Malaysia, 2018). Concurrently, Malaysia's rapid development in recent years has driven up its urban population to 71.0 per cent in 2010 from 62.0 per cent in 2000. The cities of Kuala Lumpur and Putrajaya, in particular, are fully urbanised at 100 per cent, while other major cities like Selangor and Penang are at an urbanisation level of 91.4 per cent (Department of Statistics Malaysia, 2015). In fact, the World Bank (2015) reported that Malaysia is among the most urbanised countries in East Asia, where its 4.0 per cent urban population growth rate per year is intensely urbanising rural areas (Siow et al., 2013). Considering this phenomenon, studying behavioural change towards food waste among the urban post-millennial generation in Malaysia has the potential to protect and advocate for the SDGs' agendas (Gray et al., 2019).

To examine behaviours towards food waste, this study adopted Bandura's Triadic Model of Reciprocal Determination to gain preliminary insight into the factors that constitute such behaviour. The model emphasises the interdependence between Environmental (E), Behavioural (B), and Personal (P) factors, positing that changes in behaviour are influenced by both internal individual factors and the social and physical environment (Linke et al., 2013). This study applied this model to examine Malaysian school children pursuing their primary education in an urban setting. Upon understanding where the gaps lie within the factors in the model, permaculture

principles are proposed in a modified framework for school children as a measure to minimise food waste. The outcomes provide valuable managerial and policy implications.

2. LITERATURE REVIEW

2.1. Sustainable Development Goal 2

The SDG agenda is an initiative by the United Nations that seeks to strengthen universal peace and freedom. Formed after the meeting at the United Nations Headquarters in New York in 2015, the SDGs constitute a comprehensive, far-reaching, and people-centred set of universal and transformative goals (Rosa, 2017). It envisions a future 15 years from now that is free from poverty and hunger and safe from the extreme effects of climate change. The agenda targets 169 various indicators for controlling and monitoring 17 SDGs, addressing the entire sustainable spectrum of economic, environmental, and social dimensions (Monteiro et al., 2019; Salvia et al., 2019).

SDG 2, or Zero Hunger, seeks to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture. This is a crucial goal, as both the global population and food waste are expected to grow exponentially in the years to come (Keng et al., 2020). In fact, there is already a worldwide scarcity of food and landfill space supply. Contributing factors include poor and unsustainable farming practices as well as soil and water contamination and erosion (Monteiro et al., 2019). The destruction of farmland to pave ways for urbanisation and population growth has also led to increasing food costs (Sustainable Development Goals, 2018). Malaysia is not exempt from striving towards SDG 2, as evidenced in studies emphasising the measures taken to achieve this goal (Papargyropoulou et al., 2019; Rezai et al., 2016; Sulaiman et al., 2011). At present, the food waste issue in urban Malaysia stems from households that lack information and are not environmentally conscious. Food wastage at home gives rise to greater overall food waste and impacts the life of future generations.

As such, scholars assert that education is the most effective strategy for accelerating food and nutrition security (Vogliano et al., 2021), and is a sought-after approach by governments to achieve SDG 2 (Brown, 2021). An integrated education system that addresses behavioural changes is crucial to break the food waste cycle (Jereme et al., 2016; Keng et al., 2020). Specifically, the logical way to address the food wastage challenge is to foster new educational perspectives, encompassing innovative teaching methods (Montiel et al., 2020) and open, holistic, sustainable, and integrated approaches (Fedosejeva et al., 2018). This new system should ideally prepare the next generation (i.e., post-millennials) to adopt a sustainable lifestyle, in line with the SDGs, especially since this generation is an essential stakeholder in building a sustainable future (Yamane & Kaneko, 2021). Indeed, scholars argue that post-millennials offer “new ways of seeing” in finding solutions to balance the planet, people, and profit, as they are democratising education. Studies have also shown that the younger generation shows interest in pro-SDG lifestyles, with more positive sustainable attitudes (Yamane & Kaneko, 2021). This is no exception in the Malaysian context, where Rezai et al. (2016) found that the younger generation is more open to sustainable practices and more willing to accept change in dealing with this new phenomenon. Another research in the country reported that changes in a community’s environment can change their food waste and food consumption habits for the better (Ismail et al., 2020).

Researchers have suggested various ways to achieve SDG 2, including urban agriculture (Barthel & Isendahl, 2013; Zezza & Tasciotti, 2010), the use of microorganisms as a green agricultural technology (Akinsemolu, 2018; Shearer et al., 2017), and permaculture principles in farming to enrich soil and maintain crop (Aguinaga et al., 2018). In light of the issues surrounding urbanisation, food security, and population growth in Malaysia, the study of urban agriculture and food safety is undoubtedly an important factor in the country's progress towards this SDG (Rezai et al., 2016).

2.2. Food Loss and Waste

Food security and its related concepts, such as food supply, food loss, and food wastage, have been a topic of interest in research since the 1940s, when scholars focused on studying food supply to meet war needs (Kling, 1943). Food loss is the decrease in the quantity or quality of food through the food supply chain (Kibler et al., 2018; Lemaire & Limbourg, 2019), often as a result of being discarded post-harvest (Lemaire & Limbourg, 2019; Parfit et al., 2010). The definition and terminology of food loss are not universal (Kibler et al., 2018; Thyberg & Tonjes, 2016), and the term is used interchangeably with food waste, bio-waste, kitchen waste, and preparation waste (Lemaire & Limbourg, 2019; Ong et al., 2019). Food waste is actually a subset of food loss, consisting of materials intended for human consumption that are not consumed (Kibler et al., 2018), but are instead discarded, lost, degraded, or consumed by pests (Parfit et al., 2010). Fruit, vegetables, and cereals contribute the most to food waste (Kibler et al., 2018).

With a growing population, food waste is an inevitable social problem with far-reaching consequences. The National Solid Waste Department of Malaysia reported that in 2012, food waste generated by Malaysians contributed between 31 to 45 per cent of the total volume of waste generated per day (National Solid Waste Department, Malaysia, 2016). In absolute terms, Malaysians throw away 16,688 tonnes of food daily (Sharif, 2018), and this number increases by 15 to 20 per cent during festive seasons (Jarjusey & Chamhuri, 2018). Table 1 presents the categorisation of food waste in the Malaysian context.

Table 1: Food Waste Categorisation (National Solid Waste Department, Malaysia, 2016)

Kitchen waste	Waste generated from the process of food preparation, in raw form (including roots of vegetables, fruit skins, eggshells, fish intestines, etc.)
Food residue	Waste generated or leftover from food consumption or manufacturing processes, in cooked form (including soybean husks, chicken bones, fish heads, and unconsumed food).
Expired/contaminated food	Waste generated due to expiry or over shelf life and being unsafe for consumption (refers to expired canned food, moldy bread, and rotten fruits).
Wasted food	Food that is still of good quality and edible, in both raw and cooked form, but becomes waste unnecessarily due to being unwanted or wasted (including imperfect or misshapen fruits and vegetables, unconsumed food from functions).

The National Solid Waste Department Malaysia (2016) has outlined six main strategies to address food waste: i) establishment of a database on food waste management to provide baseline measures

for future planning, ii) establishment of regulations on food waste recycling, including on reporting and waste segregation, iii) food waste minimisation at point source, iv) conversion of food waste into useful resources such as fertilizers, v) establishment of a system for food waste treatment, and vi) recovery of methane gas from landfills. These strategies are to be implemented between 2016 to 2026 to reduce food waste in three main sectors, namely the commercial sector (e.g., restaurants, food court and hypermarkets), institutions (e.g., government, schools, and hospitals), and industrial sector (e.g., food and beverage, livestock, and franchising companies). However, one limitation of these strategies is that they do not address the social aspect of food waste. Specifically, there is a lack of focus on educating consumers and industries on the importance of sustainable food consumption and waste management.

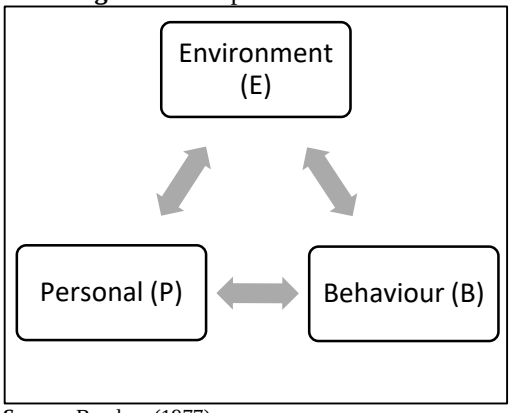
2.3. Models of Behavioural Change

Behaviourism is a research perspective that focuses on changes in the individual. Many theories have been established to understand and predict behavioural changes, among which the most extensively used are the Theory of Planned Behaviour (TPB) and Bandura's Social Learning Theory (SLT). The TPB takes centre stage in explaining an individual's intention to engage in a specific physical activity (Kwan et al., 2013). According to this theory, the stronger the intention to perform the behaviour, the more likely the behaviour will be carried out. This intention is directly influenced by three antecedent factors: attitude, subjective norms, and perceived behavioural control (Ajzen, 1991). Corresponding to these factors, individuals are more likely to engage in a behaviour if they evaluate it positively, believe that important or influential individuals have performed it, and feel they have control over the behaviour. The TPB has been used as a framework in numerous studies to predict behavioural changes among the younger generation (Fila & Smith, 2006; Kwan et al., 2013; Lien et al., 2002). However, while the theory is effective in predicting behaviour, it has limitations in accounting for the influence of emotions on students' belief structures and their intention to take action. Taylor and Todd's (1995) further found that the TPB employs unidimensional constructs in belief structures associated with attitude formation, leading to invalid behavioural predictions.

2.4. Bandura's Triadic Model of Reciprocal Determination

In general, behavioural change is an inherently complex phenomenon. Nonetheless, Albert Bandura, a prominent behavioural psychologist, made significant contributions to the study of this phenomenon by proposing the SLT. Moreover, he introduced the concept of reciprocal determinism, which highlights the dynamic and consistent interaction between a person's behaviour, the environment in which the behaviour occurs, and the characteristics of the individual performing that behaviour (Bandura, 1977; Baranowski, 1990). The Triadic Model of Reciprocal Determination, illustrated in Figure 1, has been applied to understand behavioural changes in various contexts, including lifestyle changes (Hivner et al., 2019; Linke et al., 2013), cultural shifts (Breen, 2010), and pro-environmental behaviours (Liu et al., 2019; Phipps et al., 2013).

Figure 1: Reciprocal Determinism



Source: Bandura (1977)

Bandura's reciprocal determination model emphasises that Environmental (E), Behavioural (B), and Personal (P) factors are interdependent and jointly shape changes in an individual's behaviour (Linke et al., 2013). This process is dynamic and reciprocal rather than unidirectional (Baranowski, 1990). Additionally, the relationship among the factors regulates itself (Phillips & Orton, 1983). Overall, this model is useful to predict behavioural changes and identify gaps in actual behavioural performance (Linke et al., 2013).

2.5. Justification of Bandura's Model for Behavioural Change

The development of a person's behaviour is not a monolithic event but rather a lifelong journey, and the significance of physiological function applies to both adults and children (Bandura, 1989). While both the TPB and SLT predict behavioural intentions, the SLT is a more suitable model as it takes into account a child's belief structure and emotions as predictors of behaviour. It allows for the incorporation of a child's psychobiological origins into the experiential conditions while considering the diversity in social practices, thereby enhancing and sustaining behavioural change. Therefore, as an SLT-based model, Bandura's Triadic Model of Reciprocal Determination is considered an appropriate framework for behavioural change because it recognises environmental, internal, and social factors as stimuli for behavioural shifts.

3. METHODOLOGY

A comprehensive qualitative study was conducted from February to March 2018 to explore the factors influencing food-waste related behaviour among urban post-millennials in Malaysia. Post-millennials are on track to be the most diverse and best-educated generation (Dimock, 2019), yet exhibit unethical and undesirable food wastage behaviours (Goh & Jie, 2019). Therefore, the target population of this study was Malaysian urban primary school students aged seven to 12. According to the *Senarai Sekolah Rendah KPM,* the total primary student population in the Klang Valley is 1,003,883 (Ministry of Education, 2019). Since the goal of qualitative research is not to obtain a fixed number of respondents but rather to collect sufficient in-depth information to fully describe the phenomenon under investigation (Bowen, 2008), the sample size was not predetermined in this

study. Rather, student samples were drawn using theoretical sampling until data saturation was reached (Corbin & Strauss, 2008). This sampling method was employed to uncover gaps in behavioural change relevant to the problem and population being studied.

In-depth interviews were carried out with Malaysian primary school students in urban areas, with a particular focus on the Klang Valley regions of Subang Jaya, Petaling Jaya, and Kuala Lumpur. The interviews were conducted outside of school premises and during non-school hours, with the full consent and presence of the students' parents or guardians. The legal and ethical consideration here is that the students' parents were the primary decision-makers for their children and held the right to decide on their child's participation in this research (Kortesluoma et al., 2003). Notably, interviewing children in the 7-12 age group presents challenges due to their limited linguistic development (Kortesluoma et al., 2003), which requires a slightly different approach. Therefore, this study followed the guidelines outlined by Guion, Diehl and McDonald (2011) in interviewing them, which includes (i) being open-minded, as judgment or criticism can hinder effective communication, (ii) being flexible and responsive, recognising the complexity and unpredictability of interactions with humans, and (iii) allowing the children to voice their own opinions and interpretations, rather than relying solely on adult interpretation. A total of 25 respondents were interviewed, at which point data saturation was achieved. Throughout the interviews' recordings and transcriptions, pseudonyms were used to represent respondents while maintaining their anonymity.

Thematic analysis was employed to identify, analyse, and report patterns within the data (Schinke, Bonhomme, McGannon & Cummings, 2012). This method differs from other qualitative analytical methods (Braun & Clarke, 2006), in that the construction, deconstruction, and reconstruction of themes are iteratively performed multiple times before the themes are finalised. Data trustworthiness was ensured through triangulation, where similar contexts and content in the different interviews were grouped into themes aligned with the triadic model. Peer review was also conducted with the researcher's team, who were well-versed in the study. Transferability was established by providing a clear and elaborate description of the study context for readers and other researchers interested in this investigation area.

4. RESULTS AND DISCUSSION

In summary, the 25 respondents comprised 15 female and 10 male students, aged between seven and 12, from primary schools within the Klang Valley.

4.1. Responses to Environmental Factors

Environmental factors encompass the physical environment, including the availability and accessibility of foods and the promotion of awareness campaigns. It also extends to the institutional environment (e.g., schools) as well as the social environment, which involves individuals whom the students typically interact with (e.g., peers and parents). The following are three sample responses:

Sometimes we order too much food and we cannot finish it… I know I cannot throw food away because my teachers and parents said so. But, I still see them throwing food away. Food comes from farms, supermarkets.

My parents always don't finish their food… I just throw (the food away). It makes me happy.

Some people don't have enough food. We can give our food (when unfinished) away.

Interpretation: Students appear to have plenty of access to food but have food waste behaviours that are a direct result of their environment. Some students have positive environmental reinforcements while others do not. It is evident that the environment they are exposed to raises awareness about food waste, as they are conscious of it and understand its emotional impact.

4.2. Responses to Personal Factors

Personal factors refer to one's self-identity, self-representation, knowledge, belief system, and expectations (Baranowski, 1990). These include motivational push and pull factors that shape likes and dislikes about a particular subject or behaviour. Emotions and self-efficacy are also influential personal factors. Five sample responses regarding the participants' personal factors are as follows:

It makes me feel happy (when I throw food away). Because I don't have to eat it.

It makes me feel angry when my friend does not finish his sandwich and throws it away.

I would share my food with my friends (when I don't finish it). This makes me feel satisfied.

I would give extra food to my friends and this makes me happy.

When I don't finish my food, I will throw it away. I feel disappointed with myself. But, I will ask my friends to finish their food.

Interpretation: All students, except for one, feel happy when they do not throw food away. This shows that the students have a consistent belief system in terms of the negative implications of food waste. Their motivation is mostly based on their need to socialise by sharing their food with their peers.

4.3. Responses to Behaviours

Behaviour originates from the individual level through thoughts and emotions within a particular context. It is an action with measurable output that follows a person's intention to do something about an object or situation (Solomon, 2007). Below are six sample responses on the participants' behaviours:

When I can't finish my food, I'll keep it in a container.

When my friend throws food away, I will tell him not to throw food.

We must eat less and only take what we need.

I will bring my food home and keep it in the fridge.

I will give my parents to keep in the fridge.

I will keep my food. But I normally don't eat it anymore.

Interpretation: In this context, the students' behaviour shows that they are capable of storing food for later consumption. When further probed, it was found that excess food is typically kept in the fridge until action is taken by their parents/guardians. They do not appear to know what to do with excess food apart from throwing it away or keeping it for later consumption.

4.4. Permaculture as an Environmental (E) Stimulus

Food security is recognised as a cornerstone for achieving not only SDG 2 but the SDG agenda as a whole. To attain this SDG, a cradle-to-cradle approach that ensures the establishment of a circular economy is vital. One philosophy that promotes circular food security and sustainability is permaculture, which was pioneered by Bill Mollison and Holmgern in the 1970s. Derived from the term "permanent agriculture," permaculture was founded on the principle of working in harmony with nature rather than against it. Focusing on the sustainable design of human settlements (Ferguson & Lovell, 2015), this approach represents a consciously designed agricultural system (Bill, 1979) that emphasises sustainable ecosystems, mirroring the patterns observed in nature. The primary objective of permaculture is to create a self-sustaining consumable ecosystem that counters harmful unsustainable practices (Whitefield, 2000).

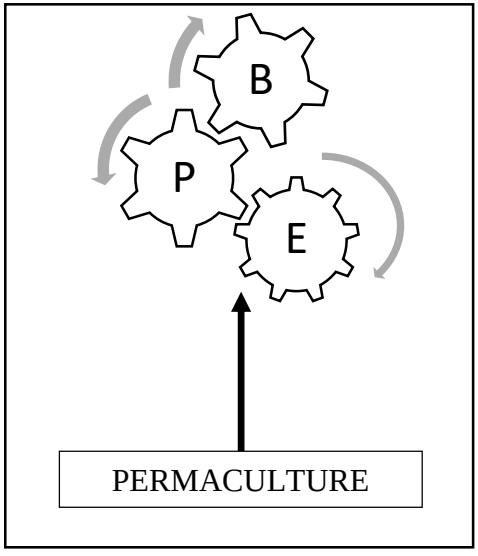
Permaculture is widely acknowledged as a means to instil sustainable practices in reducing food waste (Dangi & Jamal, 2016; Ip-Soo-Ching & Veerapa, 2015). In schools, this can be achieved through various measures, including self-sufficient kitchens, carbon emission reduction through on-site crop production, educational hubs for educators and students, recreational activities such as gardening and volunteerism, and a marketing campaign that upholds environmental sustainability as the school's objective (Ip-Soo-Ching & Veerapa, 2015).

The thematic analysis reveals that students comprehend the general importance of food and the negative implications of food waste. It is understandable that at their age, their knowledge regarding reducing food waste is limited, typically revolving around concepts such as giving away excess food and storing leftovers for later consumption. From the personal perspective, post-millennials are aware of the negative connotations of food waste and feel a desire to adhere to societal values against wastage. This suggests that they possess the knowledge that discarding edible food is wrong. However, there is also a contradictory finding where a student exhibited a positive attitude towards food waste, influenced by the environment wherein their parents are not particular about food waste themselves. Therefore, this study identifies two main gaps. First, the consumption of stored food is not addressed, with students lacking knowledge of alternatives

beyond storing leftovers. Second, the students' surrounding environment does not support broader food security concerns.

Revisiting the triadic model in Figure 1, reciprocal determinism represents a cyclical effect involving factors in the E (Environment), P (Personal), and B (Behaviour). This study reveals that by addressing the environment, external factors can influence personal factors and ultimately lead to behavioural changes. Environmental considerations for food waste can encompass activities such as converting food waste into compost, establishing edible gardens, and providing early education on food waste based on permaculture principles. In this context, if the school system integrates permaculture principles into education, permaculture can act as an environmental stimulus (E) that cultivates positive personal attitudes and feelings (P) towards reducing food waste. Subsequently, there would be a reduction in food waste behaviour (B) within the students' existing ecosystem. Figure 2 illustrates this phenomenon.

Figure 2: Permaculture as an Environment Stimulus



5. CONCLUSION

There is a constant dynamic interaction between a person's behaviour, the environment in which the behaviour occurs, and the characteristics of the person performing the behaviour (Bandura, 1978). The environment may either limit or facilitate behaviour, which can, in turn, alter the environment. Likewise, a person's beliefs may influence their behaviour, but being environmentally compelled to change behaviour could also induce a shift in beliefs (Baranowski, 1990). In the context of food security in Malaysia, as the younger generation undergoes formal education, instilling sustainable food consumption practices becomes necessary to reshape their perspective on food waste. This study reveals that necessary interventions from schools and other environmental factors can alter the younger generation's behaviours towards food wastage. This is

because, even though personal factors play an equally crucial role, children are more susceptible to changes in their external environments and are still developing their values and self-image.

Significantly, this study proposes a modified framework underpinned by a well-established theory of behavioural change, the Triadic Model of Reciprocal Determination. The modification to the framework involves the introduction of permaculture as an agent of change, which can, in turn, influence students' attitudes and behaviours. At this juncture, there are beneficial implications of using this framework for society, as it promotes sustainable living through responsible food consumption practices. It also provides a platform for school management to brand themselves as 'green schools' and position themselves as advocates of sustainable living and responsible food consumption. At the national level, implementing this framework in the primary education system serves as a foundational step in educating students on reducing food waste and cultivating food self-sufficiency. Ultimately, through the principles of permaculture, post-millennials have the opportunity to contribute to achieving SDG 2, Zero Hunger, by promoting food security, improving nutrition, and fostering sustainable agriculture practices.

However, it is important to note that the study has limitations, primarily related to its duration. A longitudinal study to examine the effectiveness of permaculture within Bandura's Triadic Model could provide more conclusive results. Such an in-depth study was not conducted at this point due to resource and time constraints. Further studies are also recommended to assess the extent to which permaculture can instil positive behavioural changes towards food wastage. The development of more comprehensive frameworks that identify relevant environmental, personal, and behavioural dimensions can offer a deeper understanding of the gaps contributing to food waste. Additionally, future research can provide evidence-based insights for policy development in Malaysia related to food waste and sustainable waste management. This can assist policymakers in formulating regulations and creating an external environment that encourages behaviour conducive to achieving SDG 2.

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