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REVIEW PAPER

Increasing resident participation in waste management through intrinsic factors cultivation

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ABSTRACT

BACKGROUND AND OBJECTIVES: Resident participation in waste management is essential to overcome waste problems effectively. In many developing countries, the local government has been struggling to encourage resident involvement in the waste management process, but the participation rate is still low. Thus, it requires a system that can encourage residents to participate effectively and sustainably. Therefore, this study aimed to determine what determinant factors, either extrinsic or intrinsic, significantly improve resident participation by changing behaviour toward waste management.
METHODS: This study tried to get insights from previous studies about key determinant factors affecting resident behaviour toward waste management to improve participation, significantly using a literature review method.
FINDINGS: Educational setting for residents is crucial to improve waste management participation by cultivating key intrinsic factors with support from extrinsic factors that lead to changing behaviour. This study identified eight types of key contents shared in the educational setting to ensure its improvement. Key intrinsic factors should be cultivated, including six kinds of knowledge and five emotional domain factors. The six critical types of knowledge include technical experience, waste management performance knowledge, perception of benefits, environmental awareness, understanding of individual and social responsibility, and understanding the social norms and regulations. The five intrinsic factors in the emotional domain include environmental efficacy, motivation, personal moral norms, PBC, and Attitude toward waste management. All the critical determinant factors, including intrinsic and extrinsic factors, should support each other to improve residents' behaviour, leading to sustainable participation.
CONCLUSION: Relevance of educational content to the residents is crucial to ensure educational intervention effectiveness. With full support from the antecedent factors, waste management behaviour can be nurtured sustainably, significantly increasing the participation rate. Combining extrinsic and intrinsic factors is recommended to ensure the effectiveness of the improvement of resident participation.

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INTRODUCTION

The accumulation of municipal waste generation is one of the main problems in every country throughout the world. Its number keeps increasing parallel with population growth, urbanization, industrialization, and economic growth (Borongan and Okumura, 2010). The waste generation will increase up to 70% from 2016 to 2050 due to massive population growth and urbanization (World Bank, 2018). Household waste commonly dominates compositional characteristics of Municipal Solid Waste (MSW) (Aleluia and Ferrão, 2016), presented by a high percentage of vegetable and food waste in the MSW composition. Table 1 shows some examples of compositional characteristics of MSW in several developing countries.

Due to their contribution to the domination of MSW, residents become one of the critical stakeholders in the waste management process (Kamaruddin *et al.*, 2017; Owamah *et al.*, 2017). Residents play various roles in the waste management process, including waste reduction (Abbasi, 2018), waste separation at source (Areeprasert *et al.*, 2018; Heidari *et al.*, 2018; Boonrod *et al.*, 2019; Priti and Mandal, 2019), and waste recycling (Kamaruddin *et al.*, 2017; Ma *et al.*, 2018). Moreover, 3 R (Reuse, Reduce, Recycle) is the most preferred solution for diverse countries due to its effectiveness in controlling waste generation (Borongan and Okumura, 2010; Modak *et al.*, 2016). Therefore, encouraging resident participation is vital (Mukama *et al.*, 2016; Song *et al.*, 2016; Sekito *et al.*, 2018) for sustainable waste management (Kawai *et al.*, 2016; Ma *et al.*, 2018; Boonrod *et al.*, 2019). Resident participation can succeed in the waste management system in many countries (Zahra *et al.*, 2012; Nmere *et al.*, 2020). Even though it is vital to involve residents in waste management process from the source, resident participation in developing countries is mostly lacking, far behind developed countries. Banerjee and Sarkhel (2019) found that 60% of cities from developed countries practice more complicated separation at source, while 87 % of cities in developing countries mix their waste and rely on authorities to handle it, implying gaps in various aspects of the waste management system (Marshall and Farahbakhsh, 2013). Furthermore, only about 20% of cities in the developing countries can process the waste further, showing a lack of knowledge and skill on waste management (Borongan and Okumura, 2010; Banerjee and Sarkhel, 2019). Thus, developing countries are still struggling in improving waste participation, especially in separation at the source step. Local governments in developing countries should find effective ways to encourage resident participation, not only on the waste separation but also in waste reduction and recycling (Kawai *et al.*, 2016). To find the strategies, it is not merely by adopting the system implemented in developed countries due to its difference in the context. Instead, there should be some consideration toward various factors, including residents' characteristics, economic, cultural, and so forth (Kawai *et al.*, 2016). Some studies showed that most developing countries relied on extrinsic strategies as the determinant factors to encourage participation and improve their behaviour toward waste management. For instance, the extrinsic approaches are policy enforcement (Heidari *et al.*, 2018; Ma *et al.*, 2018; Putri *et al.*, 2018), incentives

Table 1: MSW compositional characteristics from various cities in developing countries

Composition	Esmaeilizadeh *et al.* (2020) (Iran)	Speier *et al.* (2018) (Bangalore City, India)	Sekito *et al.* (2018) (Malang City, Indonesia)	Xu *et al.* (2016) (Xiamen, China)	Laohalidanond *et al.* (2015) (Bangkok, Thailand)
Vegetable and food waste	68,40%	56,43%	41,00%	66,19%	49,90%
Paper/cardboard	7,31%	7,67%	8,50%	9,89%	8,50%
Plastics	9,80%	8,50%	26,00%	13,17%	28,50%
PET (plastic bottle)	0,99%	-	-	-	-
Metal	1,59%	0,23%	3,60%	1,06%	1,40%
Rubber	1,09%	-	-	-	-
Textile	3,02%	4%	6%	4,38%	5,20%
Glass	2,33%	1,27%	-	3,61%	4,40%
Wood/leaves	0,97%	0,33%	9,20%	0,6%	-
Others	4,48%	21,47%	6,00%	1,10%	2,10%

as an economic motivation, and infrastructure improvement (Sari and Umanto, 2014; Putri *et al.*, 2018). However, external factors play fewer roles in changing waste management behaviour (Eneji *et al.*, 2019). These extrinsic factors cannot make a sustainable change in residents' behaviour toward waste management (Issock *et al.*, 2020), although it is more impactful for developed countries (Musella *et al.*, 2018; Mintz *et al.*, 2019). More studies are required to determine what strategies are best suited to motivate residents to participate by changing their waste management behaviour sustainably (Knickmeyer, 2019). Education is the best intervention to change people's awareness of waste management and encourage them to be involved (Chow *et al.*, 2017; Lee *et al.*, 2018; Setiawan *et al.*, 2019; So *et al.*, 2019). Education becomes the platform to share facts, information, and values for the targeted community to change behaviour through intrinsic factors in the personal domain (Stern, 1999). When intrinsic factors are pro to the waste management system, the residents will participate in the waste management process (Liao *et al.*, 2018). On the contrary, when the educational method is ineffective, it will cause problems in the waste management system (Esmaeilizadeh *et al.*, 2020). Moreover, the type of facts, information, and values being shared in education determine what intrinsic factors will be nurtured in the individuals (Janmaimool and Denpaiboon, 2016), implying that the contents play a role in determining whether education is adequate to encourage changing behaviour or not. However, studies focusing on what contents should be shared within education for the residents are rarely available. Besides, studies focusing on identifying vital intrinsic factors that should be nurtured through education are also scarce. Therefore, the objectives of the study are to figure out what key intrinsic factors play roles in improving waste management behaviour and map the contents that should be shared to nurture the key intrinsic factors. This study also identified the role of extrinsic factors to support the changing behaviour effort. Eventually, it is proposed a model that shows the relationship among the critical factors, including intrinsic and extrinsic, to change waste management behaviour. This study is a part of a doctoral dissertation titled as The implementation of knowledge management for waste management behaviour Improvement carried out at Institut Teknologi Bandung, Bandung City, Indonesia during 2019 – 2021.

MATERIALS AND METHODS

The study consists of a literature review discussing determinant factors (intrinsic and extrinsic) affecting resident participation improvement mainly in developing countries, with a unit of analysis on adults including households, public community, and academic students. This study's unit of analysis is the household, considering that adults are more dominant in dealing with waste management at the household level. The review studies included journal articles discussing waste management behaviour of residents in developing countries published in the English Language between 2015–2020 to ensure its relevance. The database sources were mainly from ScienceDirect and Proquest as the primary database, while some papers were from Mendeley, ResearchGate, and Semantic. For literature searching, this study used the basic concept of waste management behaviour where the resident involved. The term waste management in this study refers to MSW (Benešová *et al.*, 2010), in which waste generator is mainly from households (Aleluia and Ferrão, 2016). Therefore, their participation is crucial to improve the waste management system (Modak *et al.*, 2016). Waste management behaviour refers to all actions where residents must involve in the waste management process, including waste separation, waste reduction, waste recycling, waste reuse, and waste disposal behaviour (Sukholthaman *et al.*, 2017). The behaviours required in 3R are waste reduction behaviour, waste separation behaviour, waste recycling behaviour, and the combination of those behaviours. Then the Keywords used are "*waste management behavio**", "*determinant factors*", "*social factors*", "*waste separation*", "*waste reduction behavio**", "*waste recycling behavio**", "*waste minimi**", "*waste segregation behavio**", "*waste sorting behavio**", "*resident participation*", "*household participation*, "*developing countries*", and the combination among the keywords to get the most relevant papers. To ensure its quality and reproducibility, the research methodology process is based on Fink (2014), as presented in Fig. 1. This study used the NVIVO R1 tool to help the review process and map the content. The 2-3-4 processes are iterative, applying feed-back iteration to clarify the literature

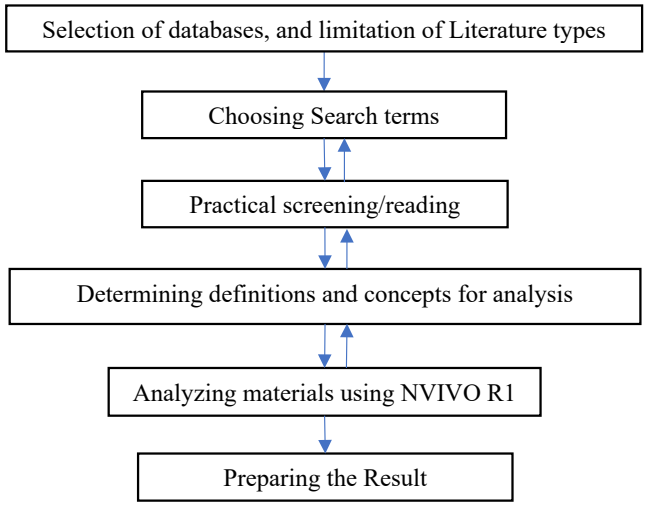


Fig. 1: The Literature Review Process (Fink, 2014)

exploration and to define the inquiry (Zacho and Mosgaard, 2016). After the assessment, 68 studies discussed determinant factors, including intrinsic and extrinsic factors affecting resident behaviour to waste management, and 38 studies identifying important contents in the education intended for resident participation improvement. According to the initial findings, the definition and concept for the content analysis process was determined.

The basic concept adopted as the framework of the study is the idea of environmental-behavioural science by Stern (1999). In environmental, behavioural science, Stern (1999) grouped the domains into three: personal/intrinsic domain, behavioural domain, and contextual/extrinsic domain. Intrinsic factors are the determinant factors from an internal or personal mind that play a role in determining individual behaviour, such as personal beliefs, moral normative, social obligations, attitude, and so forth. Behavioural domains are factors representing the intervention's effect, including activities, participation, behaviour, and habits. In behavioural change, the theories commonly focus on determinant factors influence behaviour intrinsically and recognize extrinsic factors intervening (Turaga *et al.*, 2010). According to Stern (1999), Environmental-based behaviour can be changed by giving intervention (extrinsic factors) to intervene intrinsic factors such as providing information or education system, policy or regulation, economic variables including demographic factors such as age, income, education level, and so forth. Both extrinsic and intrinsic factors affecting the behavioural domain are considered determinant factors. However, demographic characteristics in this study are excluded from the discussion due to the limitation of time and space. The analytical framework was used for initial coding, and the axial coding emerged from the analysis process. The framework analysis of this study is presented in Table 2.

Table 2: The analytical framework to guide the content analysis

No	Categories	Sub-categories	Specification
1	Determinant factors	Intrinsic factors	• All intrinsic factors affecting waste management behaviour significantly • All educational contents including facts, information and values required to nurture intrinsic factors
2		Extrinsic factors	All extrinsic factors intervening intrinsic factors that affecting waste management behaviour significantly
3	Behavioural domain	Waste management behaviour	Waste reduction behaviour waste separation behaviour waste recycling behaviour

Table 3: References focusing on identifying various determinant factors as the antecedents of waste management behaviour of residents in developing countries

No	Countries	Intrinsic factors	Extrinsic factors	Unit of analysis	References
1	China	√	√	Households	Song *et al.* (2016)
2	China	√	√	Households	Yuan *et al.* (2016)
3	China	√	√	Households	Li *et al.* (2017)
4	China	√	√	Households	Xu *et al.* (2017)
5	China	√	√	Households	Xiao *et al.* (2017)
6	China	√	√	Households	Ma *et al.* (2018)
7	China		√	Households	Meng *et al.* (2018)
8	China	√	√	Households	Liao *et al.* (2018)
9	China	√		Households	Xu *et al.* (2018)
10	China	√	√	Households	Fan *et al.* (2019)
11	China	√	√	Households	Liu *et al.* (2019)
12	China	√	√	Households	Meng *et al.* (2019)
13	China	√	√	Households	Zhang *et al.* (2019)
14	China	√	√	Households	Wang *et al.* (2020a)
15	China	√	√	Households	Wang *et al.* (2020b)
16	China	√	√	Households	Wang and Hao *et al.* (2020)
17	China	√	√	Households	Ma *et al.* (2020)
18	Columbia	√	√	Households	Padilla and Trujillo (2018)
19	Egypt	√		Households	Abdelradi, (2018)
20	Ghana	√	√	Households	Oduro-Kwarteng *et al.* (2016)
21	Ghana	√	√	Households	Addo *et al.* (2017)
22	Ghana	√	√	Households	Gyimah *et al.* (2019)
23	Ghana	√	√	Households	Alhassan *et al.* (2020)
24	Guinea		√	Households	Mamady, (2016)
25	Hongkong	√	√	Households	Yeung and Chung (2018)
26	India	√	√	Households	Wadehra and Mishra (2018)
27	Indonesia	√		Public Community	Ramadan *et al.* (2016)
28	Indonesia	√	√	Households	Trihadiningrum *et al.* (2017)
29	Indonesia	√		Households	Maryati *et al.* (2018)
30	Indonesia		√	Households	Putri *et al.* (2018)
31	Indonesia	√	√	Households	Sekito *et al.* (2018)
32	Indonesia	√	√	Households	Ulhasanah and Goto (2018)
33	Indonesia		√	Households	Setiawan *et al.* (2019)
34	Indonesia	√	√	Households	Pasaribu *et al.* (2020)
35	Indonesia	√	√	Households	Setiawan (2020)
36	Iraq	√		Households	Abdulredha *et al.* (2020)
37	Iran	√		Households	Astane and Hajilo. (2017)
38	Iran	√	√	University Students	Heidari *et al.* (2018)
39	Iran	√	√	Households	Almasi *et al.* (2019)
40	Jordan	√	√	Academy Students	Elayan and Ibrawish. (2017)
41	Malaysia	√	√	Households	Tiew *et al.* (2015a)
42	Malaysia	√		Academy Students	Ayob *et al.* (2017)
43	Malaysia	√	√	Households	Choon *et al.* (2017)
44	Malaysia	√	√	Households	Al-Naggar *et al.* (2019)
45	Malaysia	√	√	Households	Sujata *et al.* (2019)
46	Nicaragua		√	Households	Hartmann, (2018)
47	Nigeria		√	Households	Idamah, (2015)
48	Nigeria		√	Households	Nnaji, (2015)
49	Nigeria		√	Households	Nmere *et al.* (2020)
50	Pakistan		√	Households	Akhtar *et al.* (2017)
51	Palestine	√	√	Households	Al-khateeb *et al.* (2017)
52	Palestine	√	√	Households	Kattoua *et al.* (2019)
53	Palestine	√	√	Households	Salem *et al.* (2020)
54	Philippine	√		Households	Limon *et al.* (2020)
55	Thailand		√	Households	Navykarn and Muneenam, (2015)
56	Thailand	√	√	Households	Janmaimool and Denpaiboon, (2016)
57	Thailand	√	√	Households	Yukalang *et al.* (2017)
58	Thailand	√		Households	Boonrod *et al.* (2019)
59	Thailand		√	Households	Wichai-utcha and Chavalparit, (2019)
60	Trinidad & Tobago	√	√	Households	Lawrence *et al.* (2020)
61	UAE	√	√	School Students	Hammami *et al.* (2017)
62	Uganda	√	√	Households	Mukama *et al.* (2016)
63	Uganda		√	Households	Fredrick *et al.* (2018)
64	Vietnam	√	√	Households	Loan *et al.* (2017)
65	Vietnam	√		Households	Nguyen and Watanabe, (2019)
66	Vietnam		√	Households	Singer *et al.* (2019)
67	South Africa	√	√	Households	Issock *et al.* (2020)
Total Number of papers		54	57		

Table 4: Identified intrinsic factors affecting waste management behaviour

No.	Intrinsic factors	Waste reduction behaviour	Waste separation behaviour	Waste recycle behaviour	Waste management behaviour	Number of papers
1	Knowledge	√	√	√	√	28
2	Attitude to waste management	√	√	√	√	28
3	Environmental awareness	√	√	√	√	23
4	Perceived behavioural control (PBC)	√	√	√		21
5	Intention		√	√	√	15
6	Personal moral norms		√	√	√	15
7	Perception of benefits		√	√		9
8	Subjective norms		√	√		9
9	Environmental efficacy		√		√	8
10	Habits		√			6
11	Intrinsic motivation		√	√		5
12	Trust to local authorities		√			6
13	Lifestyle	√				1

The 67 identified papers that discussed determinant factors, including intrinsic and extrinsic factors affecting household waste management behaviour in developing countries, are presented in Table 3. Among 67 articles, 54 articles identified intrinsic factors, while 57 articles identified extrinsic factors. The discussion of each factor will be more explored in the next subsection.

Intrinsic factors affecting waste management behaviour

Among 54 papers discussing intrinsic factors affecting residents' waste management behaviour in developing countries, there are 13 intrinsic factors identified. All the identified intrinsic factors are presented in Table 4.

Knowledge

According to Table 4, knowledge is to be the most mentioned factors that affect all waste management behaviour being studied, including waste reduction behaviour (Astane and Hajilo, 2017), waste separation behaviour (Oduro-Kwarteng *et al.*, 2016; Ramadan *et al.*, 2016; Choon *et al.*, 2017; Trihadiningrum *et al.*, 2017; Xiao *et al.*, 2017; Xu *et al.*, 2017; Ulhasanah and Goto, 2018; Boonrod *et al.*, 2019; Fan *et al.*, 2019; Gyimah *et al.*, 2019; Kattoua *et al.*, 2019; Alhassan *et al.*, 2020; Wang *et al.*, 2020b), waste recycling behaviour (Elayan and Ibrawish, 2017; Hammami *et al.*, 2017; Trihadiningrum *et al.*, 2017; Yeung and Chung, 2018; Almasi *et al.*, 2019; Wang *et al.*, 2020a) and waste management behaviour in general (Janmaimool and Denpaiboon, 2016; Addo *et al.*, 2017; Maryati *et al.*, 2018; Al-Naggar *et al.*, 2019; Almasi *et al.*, 2019; Meng *et al.*, 2019; Pasaribu *et al.*, 2020). Some studies indicated the importance of knowledge acquisition toward residents before they participate in the waste management process. Environmental knowledge has a role in determining the degree of intention to separate in Indonesia (Ulhasanah and Goto, 2018). Knowledge related to health impact influenced positive belief of households in Luzon Region, the Philippines, toward waste management (Limon *et al.*, 2020), while lack of its knowledge caused low participation in various other countries such as Malaysia (Al-Naggar *et al.*, 2019), Thailand (Boonrod *et al.*, 2019) and China (Meng *et al.*, 2019). Technical knowledge toward waste sorting (Choon *et al.*, 2017; Almasi *et al.*, 2019; Fan *et al.*, 2019; Gyimah *et al.*, 2019; Kattoua *et al.*, 2019; Wang *et al.*, 2020b) or waste recycling technique (Xiao *et al.*, 2017; Meng *et al.*, 2019) was also proven to affect resident participation toward waste management. Lack of technical experience caused reluctance to practice the waste management process in Indonesia due to overthinking the difficulty, which may burden the households (Sekito *et al.*, 2018). Besides, when investigating factors affecting waste generation behaviour in Zanjan Province, Iran, Astane and Hajilo (2017) argued that possessing indigenous knowledge on the material use efficiency was vital in waste reduction. Even though some knowledge varieties are identified to be an influential factor for waste management behaviour, some studies found vice versa. The study conducted by Pasaribu *et al.* (2020) and Wang *et al.* (2020a)

found that knowledge was not significantly affecting intention and behaviour toward waste management, especially waste recycling. The reason can be due to information being shared was not relevant to encourage the residents toward waste management behaviour, as implied by two studies which indicated that correct knowledge affected its successfulness in changing the expected behaviour of households in Thailand (Janmaimool and Denpaibon, 2016) and Hong Kong (Yeung and Chung, 2018). Other proofs are such as the study conducted by Trihadiningrum *et al.* (2017). They found that knowledge related to the effect of solid waste toward GHG emission did not correlate Indonesian households' participation to waste separation. While the study about behaviour toward waste generation and separation in Ghana conducted by Addo *et al.* (2017) in 2016 found that moderate knowledge related to the consequence of improper waste management to health could not encourage the residents to direct practice. On the other hand, knowledge about the correlation between waste management and environmental problems significantly affected residents' attitudes in Sharjah city, UAE (Hammami *et al.*, 2017) and Kermanshah City, Iran (Almasi *et al.*, 2019). Such knowledge eventually nurtured their willingness to influence others and increased participation in waste segregation in Delhi, India (Wadehra and Mishra, 2018). It indicates that waste management behaviour requires specific information shared with the residents (Xu *et al.*, 2017). Certain information correlates with certain intrinsic factors required to improve intention and behaviour (Hammami *et al.*, 2017). As indicated by Wang *et al.* (2020a), it seemed a certain type of knowledge was required by households in 10 urban cities in China to nurture awareness, attitude, and personal moral norms. However, Oduro-Kwarteng *et al.* (2016) argued that technical separation knowledge would be able to improve motivation to do the separation, according to their study to investigate waste separation behaviour of households in Kumasi Metropolis, Ghana. So, the power of knowledge is stronger to affect intention and behaviour toward waste management, especially if the behaviour seems to burden, like recycling activities. Moreover, relevance to the type of information to improve knowledge is also crucial to pay attention to. The knowledge is supposed to address the relevant problems experienced by the residents (Knickmeyer, 2019). Thus, it should be chosen knowledge relevant to the residents where the education is conducted to ensure its effectiveness. Besides, external factors may also involve in strengthening or loosening the willingness to involve in the waste management practice, as indicated by Almasi *et al.* (2019), who reported that the primary cause of recycling practice absence in Kermanshah City, Iran according to the study in 2016 was due to lack of sufficient infrastructures.

Attitude to waste management

Attitude is a positive stance toward waste management due to various reasons, including environmental reasoning (Choon *et al.*, 2017). Attitude is another intrinsic factor, besides knowledge, which influence all of the behaviour related to waste management, including waste reduction behaviour (Astane and Hajilo, 2017), waste separation behaviour (Mukama *et al.*, 2016; Yuan *et al.*, 2016; Ayob *et al.*, 2017; Choon *et al.*, 2017; Loan *et al.*, 2017; Xu *et al.*, 2017; Heidari *et al.*, 2018; Liao *et al.*, 2018; Padilla and Trujillo, 2018; Liu *et al.*, 2019; Gyimah *et al.*, 2019; Nguyen and Watanabe, 2019; Zhang *et al.*, 2019; Alhassan *et al.*, 2020; Wang *et al.*, 2020b), waste recycle behaviour (Elayan and Ibrawish, 2017) and waste management behaviour in general (Addo *et al.*, 2017; Yukalang *et al.*, 2017; Almasi *et al.*, 2019; Meng *et al.*, 2019; Pasaribu *et al.*, 2020). Most studies found that attitude and knowledge became a critical factor in waste reduction and waste separation behaviour in various countries. Attitude correlated to the knowledge of households in Kermanshah City, Iran (Almasi *et al.*, 2019) and Hi'an, China (Liu *et al.*, 2019) while it also became vital factors directly affecting waste management behaviour of households in Iran (Astane and Hajilo, 2017), China (Liao *et al.*, 2018; Meng *et al.*, 2019), Ghana (Alhassan *et al.*, 2020), Trinidad & Tobago (Lawrence *et al.*, 2020), and academic students in Jordan (Elayan and Ibrawish, 2017). A negative attitude toward waste management became a barrier to waste management in Thailand (Yukalang *et al.*, 2017). The representation of negative attitude is such as lack of environmental concern, disbelief to the solvability of waste problems, and blaming other people due to lack of personal responsibility (Yukalang *et al.*, 2017; Liu *et al.*, 2019). It indicated that attitude is built based on environmental

awareness, environmental efficacy, and personal moral norms. For environmental efficacy, Ayob *et al.* (2017) and Elayan and Ebrawish (2017) contended that university students are likely to practice waste separation if they are sure that their actions contribute to pollution reduction and a clean environment. It implies that attitude is affected by their knowledge toward environmental conservation, which affects their environmental efficacy. The study conducted by Gyimah *et al.* (2019), which aimed at examining waste separation practice of Cape Coast Metropolis households in Ghana in 2016, indicated that attitude was also affected by knowledge toward health impacts, perception of time availability, facilities, and technical knowledge toward waste separation. While Nguyen and Watanabe (2019) contended that the positive attitude of residents in Vietnam toward waste separation was motivated by perceived benefits they got from the activities. Also, Ma *et al.* (2018) found that residents' pro-environmental attitudes in rural China was positively correlated to regulation. In this case, Ma *et al.* (2018) and Almasi *et al.* (2019) argued that external factors would be more influential when awareness of the environment is low, indicating the importance of waste separation awareness. Addo *et al.* (2017), Xu *et al.* (2017), and Almasi *et al.* (2019) also found no significant effect of attitude to waste separation intention of households. Meanwhile, Yuan *et al.* (2016) found that attitude toward waste separation behaviour negatively affected residents' waste separation behaviour in Beijing City. Yuan *et al.* (2016) explained this contrary phenomenon as resistance to change their habits. Further, they stated that household waste in Beijing was excluded from the separation program, and residents' attitudes toward separation were prepared for willingness to pay. It means that the separation process was not conducted by themselves but by the authorities. Also, it was not their habits to involve household waste into separation. Also, the study conducted in two Slums, Central Uganda (Mukama *et al.*, 2016) and the study about residents' separation behaviour in Taiyuan City, China (Liu *et al.*, 2019) indicated the role of personal and social responsibility to improve attitude through improving the residents' awareness. Personal responsibility results in personal moral norms, together with attitude, affected Anhui Province residents' intention toward waste separation in China (Wang *et al.*, 2020b). Social responsibility is supposed to raise subjective norms, which is in line with the finding of the study conducted in Hangzhou city, China, by Xu *et al.* (2017). Personal moral norms are highly required to build a powerful attitude to complement subjective norms (Liu *et al.*, 2019) because attitude is operationalized through personal feeling toward the intended action (Xu *et al.*, 2017; Zhang *et al.*, 2019). It means that subjective norms that are considered external enforcement are not enough to solely raise personal moral norms (Xu *et al.*, 2017). Consequently, a strong and intensive educational program is required to improve both knowledge and attitude (Yeung and Chung, 2018; Padilla and Trujillo, 2018; Liu *et al.*, 2019).

Environmental awareness

According to Table 4, environmental awareness becomes the third most dominant intrinsic factor mentioned by all references. It implies that awareness must be a crucial intrinsic factor for residents in developing countries to encourage waste management participation. It includes waste reduction (Abdelradi, 2018), waste separation (Janmaimool and Denpaiboon, 2016; Mukama *et al.*, 2016; Oduro-Kwarteng *et al.*, 2016; Song *et al.*, 2016; Yuan *et al.*, 2016; Trihadiningrum *et al.*, 2017; Ulhasanah and Goto, 2018; Heidari *et al.*, 2018; Fan *et al.*, 2019; Kattoua *et al.*, 2019; Nguyen and Watanabe, 2019; Zhang *et al.*, 2019; Limon *et al.*, 2020), waste recycling (Al-Khateeb *et al.*, 2017; Elayan and Ibrawish, 2017; Heidari *et al.*, 2018; Yeung and Chung, 2018; Abdulredha *et al.*, 2020; Wang *et al.*, 2020a) or waste management in general (Almasi *et al.*, 2019; Meng *et al.*, 2019). Environmental awareness is also identified as the driver of waste management participation in developed countries (Kokkinos *et al.*, 2019; Elkiran et al., 2018). Awareness becomes pivotal because it is the primary step to change personal behaviour by influencing its attitude, leading to a willingness to change. For example, the findings from the studies about waste management behaviour of households conducted in Sharjah City, UAE (Hammami *et al.*, 2017), Padang city, Indonesia (Ulhasanah and Goto, 2018) and in Macau, China (Song *et al.*, 2016) which showed the vital role of awareness. When evaluating determinant factors of waste management behaviour conducted in Rayong Province, Thailand in 2016, Janmaimool and Denpaiboon (2016) found that environmental awareness was mediated by

environmental efficacy to affect their decision to participate in the waste management process. The individual should realize their capability to contribute to environmental improvement to some extent (Janmaimool and Denpaiboon, 2016). The study in Kerbala City, Iran in 2016 (Abdulredha *et al.*, 2020), two Slums, Central Uganda (Mukama *et al.*, 2016), and Macau residents in 2011 (Song *et al.*, 2016), proved that improving people's awareness toward proper waste management process influenced the effectiveness of waste management system. Lack of environmental awareness was a barrier to waste recycling practice in two districts in Palestine (Kattoua *et al.*, 2019). A study conducted by Heidari *et al.* (2018) toward students at Ferdowsi University, Iran, in 2016 showed that awareness affected waste separation intention toward attitude and personal moral norms. This finding is agreed by Zhang *et al.* (2019), who investigated the waste separation behaviour of households in China. Zhang *et al.* (2019) showed that awareness would influence intention through personal attitude and personal moral norms. In this study, attitude is considered as the personal moral norms itself. In relation to participation, Trihadiningrum *et al.* (2017) found that 40% of residents involved in their study in Surabaya City, Indonesia stated that their reason to be involved in the waste separation activities was their awareness of the environment. Environmental awareness was also proven to affect residents' waste separation behaviour in China (Choon *et al.*, 2017; Fan *et al.*, 2019) and Vietnam (Nguyen and Watanabe, 2019). On the other hand, low environmental awareness was to be the main reason for the absence of participation in waste separation in Macau residents (Song *et al.*, 2016). Insufficient understanding of the impact of human activities toward their environment might be the cause, as indicated by the studies conducted in China in 2011 (Song *et al.*, 2016), Shanghai in 2014 (Fan *et al.*, 2019), Thailand in 2016 (Janmaimool and Denpaiboon, 2016), and Iran in 2016 (Heidari *et al.*, 2018). To nurture environmental Awareness, Janmaimool and Denpaiboon (2016), Yuan *et al.* (2016), Loan *et al.* (2017), Ulhasanah and Goto (2018), and Salem *et al.* (2020) suggested improvement on understanding toward the impacts of waste problems and the significance of the waste management practice toward environmental quality. Similarly, Abdelradi (2018) indicated that understanding food waste impacts and religious beliefs would improve residents' environmental awareness in Cairo, Egypt. Besides, Gyimah *et al.* (2019), Limon *et al.* (2020), and Salem *et al.* (2020) also suggested residents to understand waste impacts on human health for awareness improvement. Furthermore, Abdelradi (2018) and Tiew *et al.* (2015a) showed that religious beliefs could be impactful to improve environmental awareness through understanding the personal responsibility of protecting the environment (Mohamad *et al.*, 2012). This is in line with the idea from Stern *et al.* (1999) who contended that religious view probably had crucial influence to environmentalism. Nevertheless, Xu *et al.* (2016) found that religious beliefs negatively affected residents' waste generation behaviour in Xiamen Island, China. Unfortunately, there is no information about what questions were given by Xu *et al.* (2016) to measure the religious beliefs on their study, so it cannot be compared to the results to the studies conducted by Abdelradi (2018), Tiew *et al.* (2015a) and Mohamad *et al.* (2012) which showed the contrary result. In the case of religious belief influence toward environmental awareness, it seemed not to depend on the religious affiliation (Addo *et al.*, 2017; Al-Naggar *et al.*, 2019). Mohamad *et al.* (2012) found that the value of environmental awareness is impactful on various religious communities in Malaysia such as Beautiful Gates (Christianity), Tzu Chi Association (Buddhism), Surau Al-Husna (Islam), and also Batu Caves Temple (Hinduism). The influence is more likely to be the effects of implementation toward ethical and spiritual value being taught by the religions concerning environmental conservation and charity intention (Al-khatib *et al.*, 2009). Eventually, religious-based ethics and values can be included to enrich educational contents to increase environmental awareness.

Perceived behavioural control (PBC)

PBC refers to individual perception toward their capacity and possibility in conducting a particular behaviour by considering obstacles and resources supporting the expected behaviour such as the availability of time, space and facilities, convenience in doing the activities, and also their confidence in technical knowledge related to the behaviour (Xu *et al.*, 2017; Sujata *et al.*, 2019). Even though many studies considered PBC and Self-efficacy as different

constructs, Ajzen viewed these two constructs are similar because PBC consists of self-efficacy and controllability toward the intended behaviour (Sujata *et al.*, 2019). Among waste management behaviour being studied in the previous studies, PBC was dominantly investigated in studies related to waste separation behaviour. The reasons can be due to the less popularity of the recycling activity in developing countries because they are commonly encouraged to conduct waste separation. In contrast, recycling is handled by the authorities (Marshall and Farahbakhsh, 2013). On the other hand, recycling activity is commonly related to waste separation to valuable inorganic waste being sold, which does not require any treatment in advance. PBC was proven to be significant in affecting waste separation behaviour of residents in various cities in China (Yuan *et al.*, 2016; Xu *et al.*, 2017, 2018; Wang *et al.*, 2020b), residents in Ghana Millenium City (Alhassan *et al.*, 2020) and also university students in University Teknologi Malaysia (Ayob *et al.*, 2017). The main reason of perception that affected their intention to conduct waste separation is perceived time availability (Song *et al.*, 2016; Choon *et al.*, 2017; Trihadiningrum *et al.*, 2017; Gyimah *et al.*, 2019; Kattoua *et al.*, 2019; Loan *et al.*, 2017; Alhassan *et al.*, 2020; Setiawan, 2020; Ma *et al.*, 2020). Also, the perception toward time cost-burdened the residents in Klang Valley, Malaysia (Choon *et al.*, 2017) and residents in Surabaya City, Indonesia (Trihadiningrum *et al.*, 2017), causing laziness to change their past behaviour. It can be the indication that they perceived waste separation to be not easy to do (Ramadan *et al.*, 2016; Trihadiningrum *et al.*, 2017; Xiao *et al.*, 2017; Heidari *et al.*, 2018; Sekito *et al.*, 2018; Ma *et al.*, 2020). When residents think the waste separation procedure is easy, they tend to do it. Similarly, when they believe it is hard to do the separation, they tend to leave it (Choon *et al.*, 2017). Moreover, Trihadiningrum *et al.* (2017) contended that a lack of environmental concern might cause laziness toward waste separation. Besides time availability and perceived difficulty, space, as well as facilities availability, also affected residents' PBC, which eventually affect their behaviour toward waste separation as shown by the findings from various studies (Loan *et al.*, 2017; Trihadiningrum *et al.*, 2017; Gyimah *et al.*, 2019; Kattoua *et al.*, 2019; Sujata *et al.*, 2019; Alhassan *et al.*, 2020). However, the study conducted by Xu *et al.* (2017) and Zhang *et al.* (2019) showed an insignificant effect of PBC on intention in China. It can be because their behaviour toward waste separation was more influenced by subjective norms and past behaviour, instead of their capability and convenience to do it (Zhang *et al.*, 2019). It implies that regardless of their perception of their incapability in doing waste separation, they may still conduct it because it has been their habit and becomes their social culture. As a result, they may practice improperly. Accordingly, to improve PBC toward waste management behaviour, Choon *et al.* (2017) suggested that Malaysian authorities make sure that their residents have sufficient knowledge toward simple waste separation methods to lessen residents' reluctance to do the separation. Similarly, when investigating Waste Bank as a communal-based recycling system implemented in Malang City, Indonesia, in 2013, Sekito *et al.* (2018) suggested more simplicity on the separation process to elevate residents' motivation to participate. Furthermore, Liu *et al.* (2019) and Xu *et al.* (2018) suggested external factor completion such as availability of facilities, while Yuan *et al.* (2016) recommended raising resident's consciousness toward their responsibility toward waste problems to support the formation of PBC. Furthermore, personalised feedback in the form of exposure toward recyclable implementation and monitoring data dissemination is also required (Fan *et al.*, 2019; Xu *et al.*, 2018), to improve their confidence toward their capacity in implementing waste management (Wang *et al.*, 2020b; Xu *et al.*, 2018).

Intention

The intention factor is discussed mainly in the studies focusing on waste separation behaviour (Janmaimool and Denpaiboon, 2016; Mukama *et al.*, 2016; Song *et al.*, 2016; Xu *et al.*, 2017; Heidari *et al.*, 2018; Liao *et al.*, 2018; Sekito *et al.*, 2018; Ulhasanah and Goto, 2018; Fan *et al.*, 2019; Gyimah *et al.*, 2019; Issock *et al.*, 2020; Wang *et al.*, 2020b), while only two studies are investigating about waste recycling behaviour (Elayan and Ibrawish, 2017; Wang *et al.*, 2020a). Although the study by Sekito *et al.* (2018) focused on recycling behaviour in Indonesia, they investigated the intention to separate waste, which proved crucial to encourage people to conduct recycling. It is understandable since waste separation is the beginning process before waste is recycled. The

intention is often considered similar to motivation, which represents individual willingness or motivation to do or not to do something (Janmaimool and Denpaiboon, 2016). However, some studies consider it different in which motivation plays a role in describing intention (Heidari *et al.*, 2018; Fan *et al.*, 2019). Knowledge showed little correlation toward a willingness to the recycling of residents in 10 cities in China (Wang *et al.*, 2020a). Meanwhile, some other studies indicated that environmental and moral consideration factors, especially personal sense of responsibility (Mukama *et al.*, 2016; Heidari *et al.*, 2018; Liu *et al.*, 2019; Issock *et al.*, 2020; Wang *et al.*, 2020a), as well as past behaviour (Xu *et al.*, 2017) become the proper descriptors of intention to separation practice over other determinants. For example, a study conducted by Issock *et al.* (2020) aimed to analyse the influence of normative factors to waste separation behaviour of residents in Gauteng Province, South Africa, in 2019 showed that moral norms gave a more substantial and more lasting impact on intention. Thus, knowledge is not directly influential to intention, but it should be mediated by environmental awareness and personal moral norms. Elayan and Ebrawish (2017) found that recycling intention, combined with other determinant factors, influenced waste recycling implementation in Ayla Aviation Academy (AAA) in Jordan. Xu *et al.* (2017) and Wang *et al.* (2020b) also contended that Intention alone without being combined with other determinant factors might result in discrepancies between intention and behaviour. It implies that whenever one already intends to do waste management behaviour, it is still possible to do or not to do the behaviour if not supported by other determinant factors. Such a phenomenon is commonly called as an Intention-Action Gap (Hollingworth and Barker, 2017; Xu *et al.*, 2017; Wang *et al.*, 2020b). Some studies indicated that intention is correlated to external factors such as law enforcement (Song *et al.*, 2016; Ulhasanah and Goto, 2018), monetary factors (Gyimah *et al.*, 2019; Kattoua *et al.*, 2019; Alhassan *et al.*, 2020; Wang *et al.*, 2020b) and accessibility of facilities (Kattoua *et al.*, 2019; Zhang *et al.*, 2019; Alhassan *et al.*, 2020; Setiawan, 2020). However, it is worth noting that intrinsic factors are considered more impactful and more stable in driving the intended behaviour rather than external factors (Kattoua *et al.*, 2019; Issock *et al.*, 2020), while external factors tend to moderate and strengthen it (Wang *et al.*, 2020b). The disagreement between external effects and requirements to transform the intention would lead to Intention-Action Gap (Wang *et al.*, 2020b).

Personal moral norms

Personal moral norms are identified in the studies related to waste recycling behaviour (Heidari *et al.*, 2018), waste separation behaviour (Janmaimool and Denpaiboon, 2016; Yuan *et al.*, 2016; Loan *et al.*, 2017; Xu *et al.*, 2017, 2018; Heidari *et al.*, 2018; Zhang *et al.*, 2019; Issock *et al.*, 2020; Setiawan, 2020; Wang *et al.*, 2020b; Wang and Hao, 2020), waste reduction (Limon *et al.*, 2020), and waste management behaviour in general (Almasi *et al.*, 2019; Meng *et al.*, 2019; Issock *et al.*, 2020). There is no study discussing personal moral norms in waste reduction behaviour. Personal moral norms are defined as personal moral obligation or responsibility which enforce oneself to do waste management (Janmaimool and Denpaiboon, 2016; Issock *et al.*, 2020; Wang *et al.*, 2020b). It may also refer to the moral perception of waste management activities, which are good or bad, causing feeling guilty once they do or do not conduct the waste management behaviour (Loan *et al.*, 2017). Personal moral norm is sometimes called only personal norm (Loan *et al.*, 2017; Xu *et al.*, 2018) or moral norm (Issock *et al.*, 2020) or sometimes moral obligation (Xu *et al.*, 2017; Heidari *et al.*, 2018) as well. Personal moral norms are found to be the most potent descriptor of behaviour related to recycling (Heidari *et al.*, 2018; Limon *et al.*, 2020) and waste separation (Yuan *et al.*, 2016; Loan *et al.*, 2017; Zhang *et al.*, 2019; Issock *et al.*, 2020). Understanding toward separation obligation determines the acceptance of the activities (Liu *et al.*, 2019; Setiawan, 2020) even though it needs more effort to conduct it. Janmaimool and Denpaibon (2016) found that personal norms became a predisposition toward residents' behaviour in Thailand regarding waste separation. This factor becomes the indirect predictor of waste separation behaviour through attitude, as indicated by some studies (Loan *et al.*, 2017; Xu *et al.*, 2017; Heidari *et al.*, 2018; Liu *et al.*, 2019). Personal moral norms can directly affect waste separation intention and behaviour of residents in Hefei, Anhui Province, China (Wang *et al.*, 2020b) or indirectly through attitudes as found on residents' behaviour in Vietnam

(Loan *et al.*, 2017) and Hangzhou, China (Xu *et al.*, 2017). Wang *et al.* (2020b) argued that personal moral norms should be combined with awareness to correlate with waste separation attitude. Meanwhile, Meng *et al.* (2019) contended that primary intrinsic factors necessary to determine residents' behaviour are awareness, personal moral norms, and attitude to nurture intention. Wang *et al.* (2020b) involved knowledge and incentive combined with personal moral norms to improve residents' intention and behaviour toward waste separation in Anhui Province. However, according to an experiment conducted by Xu *et al.* (2018) in 2017 on Hangzhou residents, when comparing personal moral norms and incentive motivation, they found that personal moral norms were not significant in predicting waste separation behaviour. It is reasonable because the experiment study conducted by Xu *et al.* (2018) is in limited duration while changing personal moral norms takes time and needs intensive education. Hence, personal moral norms probably have not been nurtured yet when it was measured after the experiment. Personal moral norms should be combined with awareness and knowledge as other important intrinsic factors to establish attitude. Meanwhile, personal moral norms have a reciprocal relationship with social norms in a way that personal moral norms affect social norms (Xu *et al.*, 2018; Knickmeyer, 2019), while social norms are also affected by personal moral norms (Issock *et al.*, 2020; Xu *et al.*, 2018). In addition, personal moral norms can be influenced by external factors, such as authorities (Xu *et al.*, 2018; Wang and Hao, 2020). Thus, Wang and Hao (2020) suggested that China authorities evoke the residents' moral norms to nurture the intrinsic motivation of Chinese residents.

Perception of benefits

The perception of benefits was discussed in the studies related to waste separation behaviour (Li *et al.*, 2017; Heidari *et al.*, 2018; Sekito *et al.*, 2018; Fan *et al.*, 2019, Gyimah *et al.*, 2019), waste recycling behaviour (Elayan and Ibrawish, 2017) and waste management behaviour in general (Yukalang *et al.*, 2017). According to the study conducted by Gyimah *et al.* (2019) in 2016, residents in Ghana had a willingness to separate their waste if there is demand as well as a market for the valuable waste they got. Similarly, Yukalang *et al.* (2017) found that Thailand residents were unwilling to separate because they think waste had no value. Other studies found that perceived costs and benefits had the most decisive impact on the intention of residents to separate in China (Li *et al.*, 2017; Fan *et al.*, 2019; Ma *et al.*, 2020), in Vietnam (Nguyen and Watanabe, 2019) and university students in Iran (Heidari *et al.*, 2018) and various other countries. For example, the resident participation rate of separation activities in Nanjing, China, was significant and stable for more than 22 months since it first started (Li *et al.*, 2017). Every month, the residents could exchange their points to ten eggs or detergents, household-related services (e.g. sharpening knives, etc) (Li *et al.*, 2017). The points were gained from their separated waste collected by the officials. Another economic benefit is presented in Indonesian residents from Malang City who can earn 23.3 USD/ year from the waste bank, which was enough to buy school peripherals (Sekito *et al.*, 2018). Meanwhile, Thailand residents from Bangkok City can earn 15.6 USD from plastics waste and 14.2 USD from paper waste per year (Areeprasert *et al.*, 2018). In fact, Managua residents in Nicaragua gained 39% of their monthly income from waste, which was up to 185.4 USD per month (Hartmann, 2018). Consequently, 45% of Managua residents were actively involved in recycling activities as one of their income sources (Hartmann, 2018). On a medium scale, recycled organic waste that produced vermicompost worthed 80 USD/tonne in Uganda (Lim *et al.*, 2016), 106 USD/tonne in Bali, Indonesia and 180 USD/tonne in Srilanka, with 10% price increase estimation (Pandyaswargo *et al.*, 2014). For nationwide scale, the economic benefits could reach up to 11.71 million USD in Nigeria, which was equivalent to more than 16 thousand jobs/ year (Ayodele *et al.*, 2018). Economic benefits were proven to be effective to stimulate initial participation in Nanjing, China that eventually formed new habits about waste management (Li *et al.*, 2017). Besides economic benefits, perception of benefits can be in the form of environmental conservation (Ayob *et al.*, 2017; Elayan and Ibrawish, 2017), which are rooted in environmental awareness (Gyimah *et al.*, 2019; Nguyen and Watanabe, 2019; Limon *et al.*, 2020; Salem *et al.*, 2020). Environmental-based benefits were more significant in affecting waste separation behaviour of residents in Rural China (Ma *et al.*, 2020) and residents in Malaysia (Tiew *et al.*, 2015a), rather than economic-based benefits. The

insignificant effect of economic benefits could be due to a negligible amount of monetary benefits (Li *et al.*, 2017; Sekito *et al.*, 2018; Ma *et al.*, 2020). Therefore, Sekito *et al.* (2018) stated that economic value might be influential in the low economic residents since they are motivated to gaining additional income from the waste, as happened in Managua, Nicaragua (Hartmann, 2018). Sekito *et al.* (2018) also indicated that residents probably do not know the potential revenue from waste that makes them think that the waste has no value, as happened in Thailand (Yukalang *et al.*, 2017). Therefore, all related information about potential financial gains should be informed to the residents to ensure they have considered the revenue they might get (individually or communally) by practicing waste management (Sekito *et al.*, 2018). In addition, knowledge related to environmental-based benefits should also be informed to strengthen the effect. Hence, there is a balance between environmental-based reasons and the perception of waste management benefits to ensure they have sufficient motivation to participate. The combination of intensive information campaigns about environmental benefits and monetary incentives have been proven to significantly improve residents' waste segregation behaviour in India (Wadehra and Mishra, 2018). Elayan and Ebrawish (2017) suggested education such as awareness sessions or such a workshop to improve the understanding of the recycling benefits for academic students in Jordan.

Environmental efficacy

Wang and Hao (2020) mentioned the term environmental efficacy, which refers to confidence that individual efforts have the power to make environmental change. Even though some studies referred to this as self-efficacy (Janmaimool and Denpaiboon, 2016) or response efficacy (Fan *et al.*, 2019), the essence is more likely to refer to environmental efficacy. Environmental efficacy has proven to affect residents' waste separation behaviour in Shanghai, China (Fan *et al.*, 2019). In comparison, Loan *et al.* (2017) found that its effect was mediated by the Vietnamese residents' attitude, as indicated by their finding from the research conducted in urban areas in Thailand within 2015-2016. The absence of belief toward the environmental problems' solvability can be the barrier to waste management effectiveness (Yukalang *et al.*, 2017). It showed the importance of the resident's understanding of the waste management benefits, its significance in solving environmental problems caused by waste, and their roles toward waste problem-solving. Understanding of the benefits indicated the effect of perception of environmental benefits, implying its antecedent factor to environmental efficacy. Furthermore, Ramadan *et al.* (2016) found that residents in Bandung City, Indonesia, considered that the waste separation activities were ineffective, causing their reluctance in participation. Ramadan *et al.* (2016) indicated that the ineffective perception was caused by distrust to the local authorities responsible for the next step for the waste management process. Therefore, Fan *et al.* (2019) and Janmaimool and Denpaiboon (2016) suggested the authorities to educate the residents about waste separation benefits. Furthermore, Xu *et al.* (2018) implied the importance of understanding the residents' role in the waste management process to improve their environmental efficacy.

Subjective norms

Subjective Norms are the perception of an individual toward social norms. Subjective norms affected residents' intention to separate in Taiyuan City, China (Liu *et al.*, 2019) and residents in rural and semi-rural residents in Vietnam (Nguyen and Watanabe, 2019). But some studies indicated an insignificant effect to waste management behaviour, especially when compared to personal moral norms (Ayob *et al.*, 2017; Zhang *et al.*, 2019; Wang *et al.*, 2020b). However, Zhang *et al.* (2019) argued that subjective norms could be more significant in affecting intention to behaviour for the community where public perception toward their behaviour is essential (Xu *et al.*, 2017; Heidari *et al.*, 2018; Fan *et al.*, 2019; Nguyen and Watanabe, 2019; Issock *et al.*, 2020). As stated in the study by Issock *et al.* (2020), subjective norms do not include common behaviour conducted by society but more about the community's perceived expectation toward individuals. The subjective norms are applied when the expected behaviour is visible to other people to whom the perceptions are taken into individual considerations (Wang *et al.*, 2020b). It implied that subjective norms do not affect intention directly but moderating the intention to convert to action. According to Xu *et al.* (2017), subjective norms and PBC were less significant for residents in China

compared to habits. However, Stern *et al.* (1999) contended that habits might be disrupted when intervention such as educational activities improve individual dispositions that eventually form new behaviour. In this case, subjective norms can be the best way to develop new habits through social norms along with regulations, as indicated by some studies (Xu *et al.*, 2017; Liao *et al.*, 2018; Salem *et al.*, 2020;). Subjective norms can be moderated by regulation to affect Intention (Xu *et al.*, 2017). Therefore, Xu *et al.* (2017) suggested local governments in China adjust local regulation to the social norms to promote waste management behaviour toward households effectively.

Habits

Habits are defined as a series of learned acts which have been automatic and unconscious, based on specific triggers (Hollingworth and Barker, 2017). The studies about habitual factors of residents in developing countries are only found to be discussed in waste separation behaviour (Oduro-Kwarteng *et al.*, 2016; Ramadan *et al.*, 2016; Xu *et al.*, 2017; Liao *et al.*, 2018; Ulhasanah and Goto, 2018; Fan *et al.*, 2019). In comparison, habitual factors concerning recycling behaviour and reduction behaviour are only found in developed countries such as European Union (Minelgaitė and Liobikienė, 2019), Germany, and Israeli (Mintz *et al.*, 2019). Commonly developing countries are still dealing with separation problems in which residents' participation in waste separation is encouraged while recycling activities are mostly handled by the local authorities (Banerjee and Sarkhel, 2019). The study conducted by Fan *et al.* (2019), investigating the waste separation behaviour of households in Shanghai, China, in 2014, found that habits had a significant effect on Chinese residents' behaviour. The habits can be presented by repeating past behaviour, which positively influence willingness and separation behaviour (Liao *et al.*, 2018; Fan *et al.*, 2019). The effect of past behaviour is more significant to the residents in Hangzhou, China, compared to subjective norms and PBC (Xu *et al.*, 2017). The substantial effect of habits toward waste separation behaviour is also proven through the study conducted by Ramadan *et al.* (2016) and Ulhasanah and Goto (2018). They found that residents in Indonesia who were not familiar with waste separation tended to show a low willingness to do the long-term separation. Also, Oduro-Kwarteng *et al.* (2016) argued that unfamiliarity to waste separation activity, which tends to need full commitment to do, makes this activity often forgettable by Kumasi residents in Ghana, especially if separation activity is not their basic routine activities. Therefore, habits can intervene realization of intention to behaviour resulting Intention-Action Gaps phenomenon (Hollingworth and Barker, 2017). For instance, some people did not practice waste management due to laziness to change or just forgot doing it (Choon *et al.*, 2017; Trihadiningrum *et al.*, 2017). It indicated the role of habits as moderating factors toward intention to action. Xu *et al.* (2017) and Liao *et al.* (2018) suggested publication about separation performance in the public place to make public informed toward the existing behaviour. The information about the existing performance would encourage formation of social norms required to stimulate positive habits development toward waste management. In addition, habits can be enhanced by encouraging residents to practice it daily through habituation as an education method. Such a habituation process will create social norms pro to the new habit formation (Salem *et al.*, 2020). The habituation process has been successful in forming new habits of Chinese residents (Xu *et al.*, 2017; Liao *et al.*, 2018). To reduce the effect of negative habits toward waste management behaviour, Fan *et al.* (2019) encouraged strengthening the intention power to convert it to be behaviour.

Motivation

Motivation is defined as a driver (internal or external) of behaviour related to waste management. Motivation is found to be discussed in term of waste separation behaviour (Tiew *et al.*, 2015a; 2015b; Heidari *et al.*, 2018; Fan *et al.*, 2019; Limon *et al.*, 2020) and waste recycling behaviour (Heidari *et al.*, 2018; Lawrence *et al.*, 2020). Motivation is found to be a substantial determinant of the waste separation and recycling behaviour of residents in Malaysia (Tiew *et al.*, 2015a; 2015b), China (Fan *et al.*, 2019), Trinidad and Tobago (Lawrence *et al.*, 2020), and university students in Iran (Heidari *et al.*, 2018). The motivation can keep the resident behaviour longer-lasting (Tiew *et al.*, 2015a; Lawrence *et al.*, 2020). Intrinsic motivation can be nurtured based on the consideration of environmental conservation (Tiew *et al.*, 2015a; Fan *et al.*, 2019; Lawrence *et al.*, 2020)

and charity motivation as a result of personal moral obligations being nurtured by various values including religious beliefs (Abdelradi, 2018; Tiew *et al.*, 2015a; 2015b). Meanwhile, extrinsic motivation is more likely to be the result of their perception of economic benefits (Sekito *et al.*, 2018; Fan *et al.*, 2019). It implied that to develop the motivation to participate in the waste management, the residents should understand the benefits of the waste management activity for the environment and understand their role and moral obligation to keep the environment. In addition, residents should also be confident that their activity will affect the environment (Ramadan *et al.*, 2016) to ensure the transformation of the motivation to be behaviour. It indicated the importance of environmental efficacy to nurture intrinsic motivation. When intrinsic motivation has reached the maximum self-belief level, it may lower the external motivation as presented by residents in Trinidad and Tobago (Lawrence *et al.*, 2020). The internal motivation has made the recycling program in Trinidad and Tobago lasting more than three years (Lawrence *et al.*, 2020) and even lasting more than fifteen years in some religious communities in Malaysia such as Beautiful Gates, Tzu Chi Association, Surau Al-Husna, Batu Caves Temple (Mohamad *et al.*, 2012; Tiew *et al.*, 2015b). On the other hand, the absence of internal motivation may cause disinterest in participating that is considered the primary problem of waste management at the household level (Limon *et al.*, 2020).

Trust to local authorities

The studies related to trust to local authorities are found only on waste separation behaviour of residents in Vietnam (Loan *et al.*, 2017; Nguyen and Watanabe, 2019), Indonesia (Trihadiningrum *et al.*, 2017), Palestine (Salem *et al.*, 2020) and China (Wang and Hao, 2020) because waste separation activity in developing countries is typically integrated with the municipal waste management handled by the local authorities. Waste separation is the first step of the whole waste management process, conducted at the household level. The separated waste is processed further by the authorities (communal level or city level). Due to such a collaboration, trust to local authorities matters to ensure residents' participation in the waste separation process. The trust became a positive and significant driving force toward the waste separation behaviour of residents in Vietnam (Loan *et al.*, 2017; Nguyen and Watanabe, 2019) and in China (Wang and Hao, 2020). Meanwhile, Salem *et al.* (2020) reported that distrust toward authority performance on the collection step becomes a major obstacle to waste separation practice in Gaza Strip in Palestine. Similarly, Trihadiningrum *et al.* (2017) reported that when local authorities in Surabaya City, Indonesia, showed an inability in waste separation practice at the communal level in Surabaya City through its officers' performance, it affected the resident behaviour toward waste separation. Therefore, Loan *et al.* (2017) indicated that strong leadership would strengthen trust. Therefore, sharing knowledge related to the authorities' waste management performance will be effective in enhancing the trust to the authorities. However, according to the study conducted by (Wang and Hao, 2020) aimed at evaluating the role of central and local government to individual waste separation behaviour in China using China ational dataset from 2013, it was found that when the central authorities were trusted to handle the whole process of the waste management, the residents tended to shift their responsibility to the authorities. It implied that residents would not separate because they trust the government to separate the waste. Thus, improving their understanding of household responsibility on waste separation and understanding toward the mutual partnership between residents-authorities is required.

Life style

The lifestyle factor seemed less interesting to be analysed when discussing about determinant factors of waste management behaviour. Lifestyle is taken into consideration based on the study conducted by Choon *et al.* (2017), focusing on the waste reduction behaviour among Malaysian residents, specifically in the Klang Valley. Choon *et al.* (2017) identified three primary reasons for individuals not using a recycle bag: "forget", "laziness to change," and "have no time doing that". According to the three reasons mentioned, it seemed that Lifestyle could be a representation of Habits that are highly correlated to past behaviour and PBC (Oduro-Kwarteng *et al.*, 2016; Choon *et al.*, 2017; Trihadiningrum *et al.*, 2017). Due to its similarity, lifestyle will not be discussed further in this study because lifestyle factor is embedded in habits factors.

Extrinsic factors affecting waste management behaviour

There are 5 extrinsic factors identified from 57 studies which are directly affecting the intrinsic factors. The identified extrinsic factors are education, economic factor, supporting facilities, regulation related to waste management, and social norms. The number of papers mentioning each factor is presented in Table 5.

Waste management education

Education toward waste management is one of the most dominant factors affecting intrinsic factors since it is the most highly mentioned factor in 29 papers. Effective education is often considered as a robust solution to nurture intrinsic factors effectively to improve waste management behaviour (Idamah, 2015; Nnaji, 2015; Oduro-Kwarteng *et al.*, 2016; Al-Khateeb *et al.*, 2017; Choon *et al.*, 2017; Padilla and Trujillo 2018; Wadehra and Mishra, 2018; Kattoua *et al.*, 2019; Lawrence *et al.*, 2020; Nmere *et al.*, 2020). Even though extrinsic factors are available such as infrastructure, there is no assurance that the residents want to participate if they have no proper environmental awareness and technical knowledge toward the activity (Kattoua *et al.*, 2019). The educational system is supposed not only applied to the formal system (such as school-based or college-based education), which is commonly intended for youth (Singer *et al.*, 2019). The local government should provide an educational system specifically designed for adults as well in the concept of resident-based education (Singer et al., 2019; So *et al.*, 2019). The waste management education will improve specific residents' knowledge to nurture various intrinsic factors needed to improve participation (Navykarn and Muneenam, 2015; Liu *et al.*, 2019). Moreover, some studies found that educational contents being shared in resident-based education play a vital role in determining which intrinsic factors being nurtured (Janmaimool and Denpaiboon, 2016). Different contents emphasized in the education activities may affect various intrinsic factors (Song *et al.*, 2016; Al-Naggar *et al.*, 2019; Fan *et al.*, 2019; Wang *et al.*, 2020b). Meanwhile, it needs intrinsic factors to effectively improve waste management behaviour (Navykarn and Muneenam, 2015). Thus, it is crucial to determine what contents should be shared in the resident-based education to ensure its effectiveness in encouraging their waste management participation. After a more thorough investigation to identify the educational contents required, 38 papers mentioned what knowledge they suggested or already applied in their education system to improve resident participation in waste management. The content analysis of all the selected papers is mapped using the NVIVO R1 tool and presented in Table 6. The educational contents shown in Table 6 should be disseminated to the residents through resident-based education. The education is supposed to be conceived in a durable education program to ensure its effectiveness in conveying the learning contents (Oduro-Kwarteng *et al.*, 2016; Loan *et al.*, 2017; Knickmeyer, 2019). A long-term education program also allows continuous learning leading to accumulative improvement on intrinsic factors and waste management performance (Yeh *et al.*, 2016). Knowledge sharing activities can use various techniques and approaches involving multiple media and applying communication strategies adjusted to the residents' characteristics (Mamady, 2016; Knickmeyer, 2019). The educational setting might allow intensive interaction such as face-to-face interaction for better knowledge internalization (Knickmeyer, 2019), involving internet (Padilla and Trujillo, 2018) and learning-by-doing to encourage changing behaviour and improve waste management performance (yeh *et al.*, 2016). The Learning-by-

Table 5: Identified extrinsic factors affecting waste management behaviour

No	Intrinsic factors	Waste reduction behaviour	Waste separation behaviour	Waste recycle behaviour	Waste management behaviour	Number of papers
1	Waste management Education		√	√	√	29
2	Economic factor	√	√	√	√	27
3	Facilities	√	√	√	√	27
4	Regulation	√	√	√	√	20
5	Social norms		√	√	√	16

Table 6: Educational contents to nurture intrinsic factors

Type of contents	Terms	Intrinsic factors nurtured	References
1. Skills on waste management practice	• Method of waste storage, waste separation, waste reuse, waste recycle, waste disposal • Simple tips for waste management practice • Personal waste management • Tips on material use efficiency	Technical knowledge, PBC	Navykarn and Muneenam (2015); Tiew *et al.* (2015b); Janmaimool and Denpaiboon (2016); Oduro-Kwarteng *et al.* (2016); Song *et al.* (2016); Astane and Hajilo (2017); Choon *et al.* (2017); Elayan and Ebrawish (2017); Xiao *et al.* (2017); Fredrick *et al.* (2018); Sekito *et al.* (2018); Ulhasanah and Goto (2018); Yeung and Chung (2018); Al-Naggar *et al.* (2019); Gyimah *et al.* (2019); Kattou *et al.* (2019); Singer *et al.* (2019); Salem *et al.* (2020); Wang *et al.* (2020b); Wang and Hao (2020)
2. Bad impacts of waste	• Environmental problems (e.g. pollutions, damages) • Disasters (e.g. flood) • Health problems • Landfill problems	Environmental awareness	Navykarn and Muneenam (2015); Song *et al.* (2016); Janmaimool and Denpaiboon (2016); Mamady (2016); Mukama *et al.* (2016); Trihadiningrum *et al.* (2017); Yukalang *et al.* (2017); Fredrick *et al.* (2018); Yeung and Chung (2018); Al-Naggar, *et al.* (2019); Fan *et al.* (2019); Gyimah *et al.* (2019); Kattou *et al.* (2019); Lawrence *et al.* (2020); Limon *et al.* (2020); Wang *et al.* (2020b)
3. Importance of proper waste management practice	• Consequence of improper waste management to environment • Contribution to waste reduction • Importance of waste reduction, waste separation, waste recycling, waste disposal,	Attitude, environmental awareness, PBC	Nnaji (2015); Yuan *et al.* (2016); Choon *et al.* (2017); Elayan and Ebrawish (2017); Loan *et al.* (2017); Ma *et al.* (2018); Kattou *et al.* (2019); Sujata *et al.* (2019); Limon *et al.* (2020); Salem *et al.* (2020); Wang and Hao (2020)
4. Individual and social roles of waste problems using environmental and religious value approach	• Impact of human activities toward environment • Responsibility to the environment and handling waste • Significance of individual and community participation to waste management for solution to environmental problems	Understanding on individual and personal responsibility, personal moral norms	Tiew *et al.* (2015a); Janmaimool and Denpaiboon (2016); Mukama *et al.* (2016); Yuan *et al.* (2016); Almasi *et al.* (2019); Al-Naggar, *et al.* (2019); Lawrence *et al.* (2020); Wang and Hao (2020)
5. Information about the existing performance of waste management	• Operational cost of handling waste • Feedback on the recycling/separation practice • Comparison between recent recycling/separation behaviour and predefined standard	Knowledge about WM performance, self-efficacy, habits, trust to authorities	Tiew *et al.* (2015b); Yuan *et al.* (2016); Liao *et al.* (2018); Yeung and Chung (2018); Kattou *et al.* (2019); Setiawan *et al.* (2019)
6. Environmental Issues	• Environmental news • Environmental phenomena • Environmental protection & resource conservation	Environmental awareness	Idamah (2015); Janmaimool and Denpaiboon (2016); Song *et al.* (2016); Choon *et al.* (2017); Elayan and Ebrawish (2017); Fan *et al.* (2019)
7. Information toward extrinsic factors (regulation, social norms)	• Informing the existence of social norms toward 3R • Informing about available recycling facilities • Informing about regulation toward 3R	Knowledge about regulation and social norms, attitude, subjective norms	Janmaimool and Denpaiboon (2016); Choon *et al.* (2017); Liao *et al.* (2018); Yeung and Chung (2018)
8. Economic value of waste and its marketing opportunity	• Profit from selling recycle waste • Tips on marketing of recyclable waste • Possible revenue from selling valuable waste	Perception of benefits	Yukalang *et al.* (2017); Fredrick *et al.* (2018); Sekito *et al.* (2018); Kattou *et al.* (2019)

doing method can be implemented through social norms and regulation enforcement that allow the residents' habituation process.

Economic factors

There are 27 studies found discussing economic factors related to waste management behaviour. Economic factors refer to any economic or financial system involved to encourage waste management participation. The economic factors are presented in either reward or punishment provided by the local government. Reward concept can be through discounted taxes (Gyimah *et al.*, 2019; Kattoua *et al.*, 2019; Meng *et al.*, 2019), daily-good exchanges (Li *et al.*, 2017), financial incentives (Mukama *et al.*, 2016; Ng and Wang, 2017; Xiao *et al.*, 2017 Heidari *et al.*, 2018; Liao *et al.*, 2018; Ma *et al.*, 2018; Wadehra and Mishra, 2018; Fan *et al.*, 2019; Gyimah *et al.*, 2019; Wichai-utcha and Chavalparit, 2019; Salem *et al.*, 2020; Ma *et al.*, 2020; Wang *et al.*, 2020b), or a market system that enables residents to sell their recyclable waste (Tiew *et al.*, 2015a; Elayan and Ibrawish, 2017; Trihadiningrum *et al.*, 2017; Hartmann, 2018; Sekito *et al.*, 2018; Kattoua *et al.*, 2019; Meng *et al.*, 2019; Almasi *et al.*, 2019; Alhassan *et al.*, 2020). The punishment concept can be in the forms of a waste charge (Song *et al.*, 2016; Addo *et al.*, 2017; Xiao *et al.*, 2017; Yukalang *et al.*, 2017; Meng *et al.*, 2018), such as Pay As You Throw (PAYT) concept (Oduro-Kwarteng *et al.*, 2016; Addo *et al.*, 2017; Xiao *et al.*, 2017). Wang *et al.* (2020b) found that financial incentives can lower gaps between intention-behaviour on residents in Hefei, Province of Anhui, China. Similarly, Li *et al.* (2017) found that the daily-goods exchange concept implemented in Nanjing City, China, was also proven successful in encouraging the residents' stable participation toward waste separation programs. To encourage recyclable inorganic waste, some countries such as Indonesia (Trihadiningrum *et al.*, 2017; Sekito *et al.*, 2018), Malaysia (Tiew *et al.*, 2015a), and Nicaragua (Hartmann, 2018) provided a market system that enables the residents to sell their recyclable inorganic waste. By informing the potential revenue from the separated waste, the residents will know the economic benefits and are expected to be more interested in participating actively in the waste management program (Sekito *et al.*, 2018). However, financial rewards were commonly significant in affecting the motivation of low-income residents to participate in waste separation (Addo *et al.*, 2017; Ng and Wang, 2017; Hartmann, 2018; Sekito *et al.*, 2018; Almasi *et al.*, 2019; Kattoua *et al.*, 2019; Alhassan *et al.*, 2020), and were not significant for high-income residents (Meng *et al.*, 2019). High-income people tend to think that the revenue is meagre and not worth the efforts (Yukalang *et al.*, 2017; Sekito *et al.*, 2018). Therefore, they felt reluctant to participate (Yukalang *et al.*, 2017). However, even though financial rewards gave less motivation to participate (Tiew *et al.*, 2015a), the charity motivation played a more significant role that keeps Malaysian residents willing to participate in the recycling activities. Another factor affecting waste management participation concerning economic factors is the cost burden, as found on rural residents in China (Ma *et al.*, 2020) and Malaysia residents (Tiew *et al.*, 2015a). With the same logic, punishment for absence in participation, leads to additional cost and might be powerful to encourage residents to participate. The punishment concept allows local government to charge residents for their waste through the PAYT mechanism. Even though the PAYT concept implementation had an insignificant impact in some areas, such as in Xiamen City, China (Xiao *et al.*, 2017), but it was effective for some other areas such as Macau (Song *et al.*, 2016) and Suzhou, China (Meng *et al.*, 2018). The reasons can be because of the benefits received such as improvement on services, or because of expense avoidance. PAYT concept may be more suitable for high-incomes cities where the residents want to pay more for better waste management service (Song *et al.*, 2016). The cities already have a good system for waste management and policy-related enforcement. Thus, PAYT will not give misleading messages, such as encouraging residents to dispose their waste improperly due to expense avoidance. For better implementation, Oduro-Kwarteng *et al.* (2016) suggested implementing a drop-off concept in Kumasi Metropolis, Ghana, to allow residents to drop-off their recyclable waste without charging them. The bill will be reduced if the residents want to bring their waste themselves. Nevertheless, Xiao *et al.* (2017) stated that the charging concept is a less preferred option for Xiamen residents even though it has been widely used due to its feasibility to reduce waste for other countries.

Supporting facilities

There were 27 studies discussing about supporting facilities for waste management to

improve participation (Song *et al.*, 2016; Akhtar *et al.*, 2017; Hammami *et al.*, 2017; Trihadiningrum *et al.*, 2017; Fredrick *et al.*, 2018; Liao *et al.*, 2018; Almasi *et al.*, 2019; Fan *et al.*, 2019; Kattoua *et al.*, 2019; Meng *et al.*, 2019; Zhang *et al.*, 2019; Alhassan *et al.*, 2020; Lawrence *et al.*, 2020; Setiawan, 2020; Wang *et al.*, 2020b). Some factors to consider related to supporting facilities include the accessibility of the collecting point facilities from the residentials (Tiew *et al.*, 2015a; Nnaji, 2015; Addo *et al.*, 2017; Choon *et al.*, 2017; Yukalang *et al.*, 2017; Gyimah *et al.*, 2019; Meng *et al.*, 2019; Ma *et al.*, 2020; Alhassan *et al.*, 2020), the capacity and sufficiency of the facilities (Nnaji, 2015; Akhtar *et al.*, 2017; Choon *et al.*, 2017; Heidari *et al.*, 2018; Kattoua *et al.*, 2019), the variability for various types of waste (Lawrence *et al.*, 2020), and the arrangement of the storage and its appearance (Oduro-Kwarteng *et al.*, 2016; Choon *et al.*, 2017). For the area where space available is limited to place the facilities near to the residents, it is recommended to implement a kerbside waste collection system, a service given to the households to collect and dispose of the separated waste to the collecting point (Oduro-Kwarteng *et al.*, 2016). In this case, the waste charging system will affect its success to encourage participation. Liu *et al.* (2019) indicated that supporting facilities affected the PBC of residents in Taiyuan City, China. Wichai-utcha and Chavalparit (2019) argued that when supporting factors were combined with financial incentives and implementation of regulations, supporting facilities improved waste management participation of residents in Thailand. However, it is found a negative moderating effect of facilities' availability to the participation rate in Shanghai due to an absence of supervision process (Fan *et al.*, 2019). Moreover, Zhang *et al.* (2019) stated that supporting facilities factors were not significant in moderating the Intention-Behaviour Gap of waste separation behaviour in Taishan District, Shandong Province, China. Instead, facilities can directly affect the residents' waste separation behaviour (Zhang *et al.*, 2019). In this case, Zhang *et al.* (2019) argued that people could separate their waste once they find supporting facilities around them, supporting with knowledge toward government support. In this regard, Kattoua *et al.* (2019) explained that there is no insurance that residents will participate if they have no intrinsic factors to support the behaviour. Lawrence *et al.* (2020) contended that when the intrinsic driver is strong (e.g. environmental-based reasons), there is no need for the external driver to motivate the residents. In this way, external factors have functioned as the moderator of intention to real action as what was found in Trinidad & Tobago. Therefore, encouraging residents from improving intrinsic factors is highly recommended, while the external supports are combined in strengthening the effects, especially for the residents who still have low internal drivers.

Regulation related to waste management

The implementation of regulation in waste management has been discussed in 20 studies. Regulation can be related to official recycling program (Kattoua *et al.*, 2019) along with the organizational plan about waste management procedure (Almasi *et al.*, 2019), including regulation about waste separation process (Gyimah *et al.*, 2019), recycling and waste reduction process (Oduro-Kwarteng *et al.*, 2016). Xiao *et al.* (2017) found that regulation became the least favourable choice to improve residents' participation in Xiamen City, China, compared with knowledge and social norms. Regulation tended to lack application and control and was considered only a conditional instrument (Xiao *et al.*, 2017). Ma *et al.* (2018) reported that regulation was significant in affecting the pro-environmental attitude of residents in Guangxi Zhuang, China, according to their study conducted in 2014. Meanwhile, two studies found that regulations were not statistically significant in encouraging the residents' waste management behaviour in Suzhou, China (Meng *et al.*, 2019) and South Africa (Issock *et al.*, 2020). Meng *et al.* (2019) explained that because the regulation implemented in Suzhou, China was limited to the incentive system and instruction without mandatory encouragement. Moreover, Meng *et al.* (2019) indicated that voluntary motivation was less recommended due to low power to enforce participation, which was agreed by other studies (Ma *et al.*, 2018; Putri *et al.*, 2018; Wichai-utcha and Chavalparit, 2019; Wang *et al.*, 2020a). On the other hand, Issock *et al.* (2020) argued that the insignificancy effect of regulation toward residents' waste management behaviour in South Africa because the residents did not know yet about the regulation. Also, Wang and Hao (2020) argued that the contrary effects of government intervention

(regulation) found in various studies were due to the different expectations between the government and the social norms. It indicated a mutual correlation between regulation and social norms, which are expected to be in line. Thus, it can be concluded three things: First, the regulation should encourage mandatory participation to establish social norms (Liao *et al.*, 2018; Wang *et al.*, 2020a; Issock *et al.*, 2020). Second, there should be accordance between the regulation and the social norms. In this case, explicit instruction and guidelines to create a more supportive environment are also encouraged (Oduro-Kwarteng *et al.*, 2016; Yukalang *et al.*, 2017; Salem *et al.*, 2020) to build new habits of the community that is pro to waste management. Third, it is essential to disseminate regulation to ensure that the residents have sufficient knowledge about it (Sujata *et al.*, 2019). Sufficient knowledge toward the regulation can be relied on for the participation initial stage (Ma *et al.*, 2018). It implies that education should involve regulation dissemination and socialization to enable the residents to understand their expected roles. However, as indicated by Sujata *et al.* (2019) and Wichai-utcha and Chavalparit (2019), it is worth noting that educating residents merely on regulation dissemination is less effective in improving participation. Support from other extrinsic factors is required, such as economic factors and supporting facilities (Yeung and Chung, 2018; Wichai-utcha and Chavalparit, 2019; Salem *et al.*, 2020). Furthermore, based on the study's finding by (Xu *et al.*, 2017), it is implied that the effectiveness of regulation can moderate subjective norms to intention while also translating PBC to behaviour.

Social norms

There were 16 studies related to social norms, with diverse terms such as local trends in the area (Choon *et al.*, 2017), public praise (Liao *et al.*, 2018), cultural norms (Pasaribu *et al.*, 2020), and community norms (Janmaimool and Denpaiboon, 2016). Social norms also include social pressure from families (Yuan *et al.*, 2016; Loan *et al.*, 2017; Xiao *et al.*, 2017), neighbours (Yuan *et al.*, 2016; Xiao *et al.*, 2017; Meng *et al.*, 2019), friends or even local leaders (Trihadiningrum *et al.*, 2017) which enable to give impact to individual behaviour toward waste management. The social norms are converted to subjective norms on individuals, based on their perception of the norms. Issock *et al.* (2020) differentiated between descriptive norms, norms coming from other people's behaviour, and injunctive norms, norms coming from other people's expectations. They indicated that injunctive norms are more impactful than descriptive norms (Issock *et al.*, 2020). It could be because the motivation to do the action is more likely to be face-saving than care for the environment (Liao *et al.*, 2018). According to many previous studies, social norms showed a significant effect on the intention to do waste management behaviour directly (Choon *et al.*, 2017; Wadehra and Mishra, 2018; Meng *et al.*, 2019; Issock *et al.*, 2020; Pasaribu *et al.*, 2020) or through subjective norms (Trihadiningrum *et al.*, 2017; Xiao *et al.*, 2017; Xu *et al.*, 2017; Liao *et al.*, 2018; Ulhasanah and Goto, 2018; Sujata *et al.*, 2019). However, Sujata *et al.* (2019) contended that even though social norms significantly affect intention, the effect is small. It is because social norms are commonly powerful for behaviour, which are seen by other people, while the intention is invisible (Wang *et al.*, 2020b). Furthermore, Zhang *et al.* (2019) implied that intention is more likely to be affected by personal moral norms rather than subjective norms (Zhang *et al.*, 2019; Issock *et al.*, 2020; Wang *et al.*, 2020b). While it is found the contrary result of whether social norms are influential in both urban areas (Choon *et al.*, 2017) and the rural areas (Janmaimool and Denpaiboon, 2016), it seems that the effect is relied on the cultural background, in which face-saving is prevalent in the areas (Liao *et al.*, 2018). Likewise, Janmaimool and Denpaiboon (2016) and Meng *et al.* (2019) argued that social norms are strongly required by the community where public expectation has a strong effect on encouraging resident behaviour. The community may influence subjective norms from the family members, friends, or neighbour's behaviour (Loan *et al.*, 2017) once the individual thinks that their behaviour matches the community norms (Xiao *et al.*, 2017). In the case where social norms affect individual behaviour, Xiao *et al.* (2017) contended that the influence is stronger than the effect of regulations. It should be noted that the effect is also depending on how far the individual understand the norms (Janmaimool and Denpaiboon, 2016). Thus, residents' understanding toward social norms should be improved through massive promotion (Janmaimool and Denpaiboon, 2016; Meng *et al.*, 2019), especially in the area where face-saving or public expectation

plays a vital role in their culture. Eventually, social norms should be included in the educational content to ensure the residents understand it.

Proposed model

Based on a thorough analysis of waste management behaviour conducted previously, the proposed model is built based on two primary areas: extrinsic and intrinsic factors. The extrinsic factors refer to any intervention factors outside the personal domain that could affect personal behaviour. In contrast, intrinsic factors are determinant factors inside the personal domain that involves the behaviour realization process (Stern, 1999). In the area of intrinsic factors, there are three primary domains: knowledge, emotional and behavioural level, which are inspired by the behavioural theory concepts indicating the process of how an individual can finally do a certain behaviour (Lickona, 1991; Stern, 1999; Ajzen, 2005). Some interventions can be involved to improve personal behaviour. Previous studies related to waste management behaviour identified that extrinsic factors were significantly affecting the improvement of waste management behaviour, including education, economic factors, supporting facilities, regulations, and social norms. The education is to share facts, values, and information as the education contents (Stern, 1999). Relevant contents being shared in the educational system are vital to ensure the relevance of knowledge received by the households, which are significantly influential in improving certain intrinsic factors (Janmaimool and Denpaiboon, 2016; Hammami *et al.*, 2017; Xu *et al.*, 2017; Yeung and Chung, 2018). It is identified eight primary contents required to be educated to the households, as shown in Table 6. The contents should address the relevant issues to make them effective (Knickmeyer, 2019). The education will improve technical knowledge (including skills on doing the waste management procedure), knowledge about recent waste management performance in the given area, the perceived environmental and economic benefits from waste management, environmental awareness, knowledge about relevant social norms and regulations, and also understanding toward residents' responsibility to waste management. The direct effect of knowledge acquired by the residents improves key intrinsic factors on the emotional level (Hammami *et al.*, 2017; Xu *et al.*, 2017; Wang *et al.*, 2020a), such as residents' trust toward authorities, environmental efficacy, motivation, personal moral norms, and subjective norms. The perceived norms from the community have reciprocal effects on personal moral norms. On the other hand, the combination of personal moral norms and motivation will be powerful to improve attitude toward waste management (Mukama *et al.*, 2016). The motivation should be nurtured through the combination of perception of benefits and environmental awareness (Wadehra and Mishra, 2018) while also influenced by environmental efficacy (Ramadan *et al.*, 2016) and personal moral norms, as a result of understanding toward residents' responsibility toward the environment (Abdelradi, 2018; Tiew *et al.*, 2015a). The environmental efficacy itself should be built from the perception of benefits, environmental awareness, understanding of responsibility, and trust to the authorities, which is the effect of knowledge toward recent waste management performance (Wang and Hao, 2020; Xu *et al.*, 2018). The combination of technical knowledge, support of facilities, and environmental efficacy will improve PBC (Yuan *et al.*, 2016; Xu *et al.*, 2018; Liu *et al.*., 2019). When PBC is combined with motivation and personal norms, it will affect the attitude toward waste management (Yuan *et al.*, 2016; Yukalang *et al.*, 2017; Liu *et al.*, 2019). The given attitude will eventually cause the intention to do waste management (Addo *et al.*, 2017; Xu *et al.*, 2017; Almasi *et al.*, 2019). The PBC and personal moral norms separately can also cause intention to do waste management, but the intention will be weak if there is no existing positive attitude (Mukama *et al.*, 2016; Heidari *et al.*, 2018; Liu *et al.*, 2019; Issock *et al.*, 2020; Wang *et al.*, 2020a). When it comes to converting intention to behaviour, economic factors, subjective norms, and the existing habits play as moderating factors that may loosen or strengthen the realization (Kattoua *et al.*, 2019; Issock *et al.*, 2020; Wang *et al.*, 2020b). If the intention is weak due to a lack of support from antecedents and extrinsic factors, the existing habits will determine the behaviour realization (Wang *et al.*, 2020b). Therefore, the key contents in the educational system should meet the requirements, and those key contents should be able to nurture the determinant factors from the intrinsic domain to strengthen the intention. Further, the intention which comes from intrinsic factors will be converted to more sustainable behaviour (Kattoua

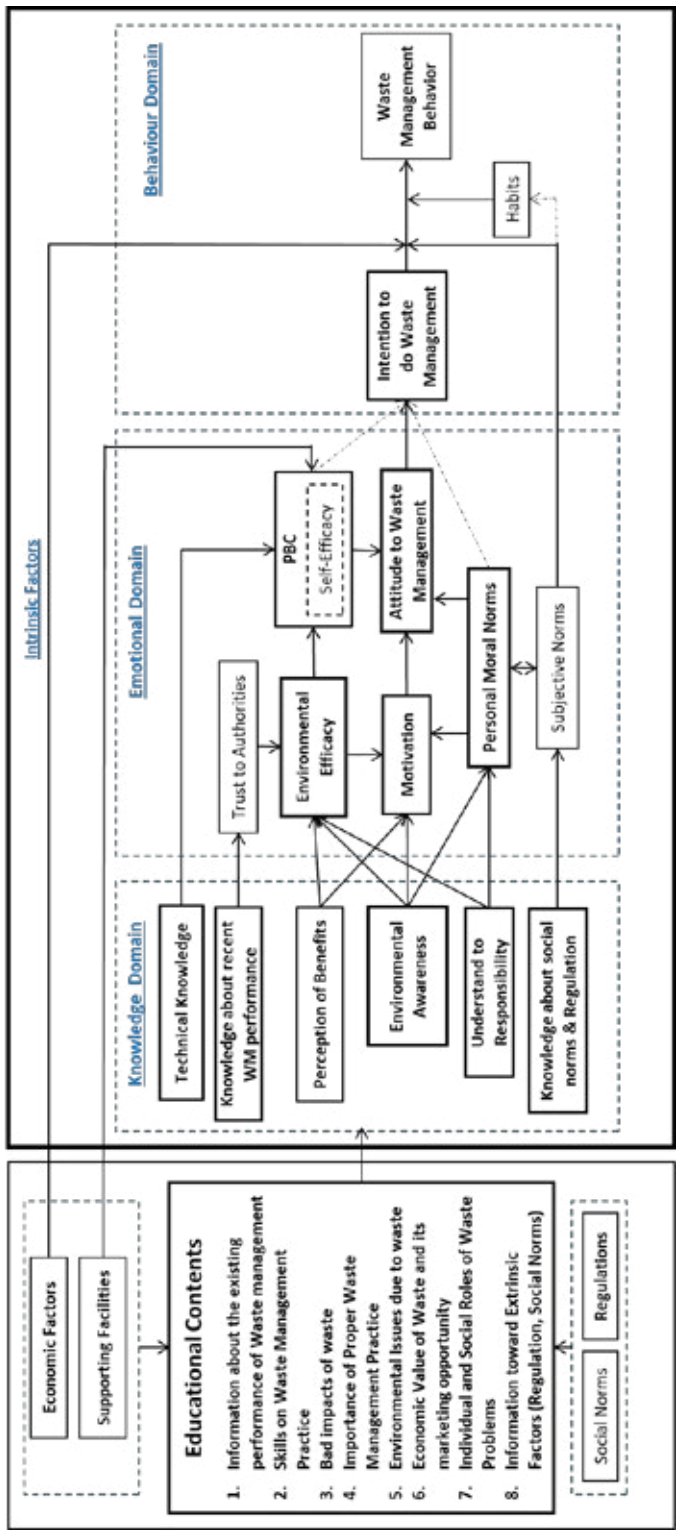


Fig. 2: The relationship among intrinsic and extrinsic factors affecting waste management behaviour

et al., 2019; Zhang *et al.*, 2019; Issock *et al.*, 2020), especially when extrinsic factors and habits are fully supporting. As a result, the residents willingly participate in waste management actively. The relationship among all identified determinant factors is presented in Fig 2. The bold-written variables in the figure show the emphasis of its urgency based on the literature's support and the cruciality of the existence in the model.

Model formulation

According to Fig. 2, It is seen that among external factors, educational contents become the crucial factors that should be existed to ensure improved behaviour on waste management through intrinsic factors improvement. Extrinsic factors are required as moderating factors that are intended to strengthen their realization. Subjective norms come from social norms, which are only significant for the community that considers social perception toward them is important (Xu *et al.*, 2017; Heidari *et al.*, 2018; Fan *et al.*, 2019; Issock *et al.*, 2020). Meanwhile, there is a reciprocal correlation between personal norms and subjective norms. Thus, personal moral norms can be representative for the subjective norms. Therefore, subjective norm factor is omitted in the model. Furthermore, social norms can be combined with regulation to lead to new habits establishment (Xu *et al.*, 2017; Li *et al.*, 2017; Liao *et al.*, 2018; Salem *et al.*, 2020). Such a habituation approach becomes an effective educational method to make the residents familiar with the behaviour (Lickona, 1991) because it allows learning by doing (Yeh *et al.*, 2016). Once the behaviour becomes habits, it reduces the dependence on external factors such as economic factors (Li *et al.*, 2017). The habituation will strengthen the behaviour improvement by making it mandatory (Liao *et al.*, 2018; Wang *et al.*, 2020b; Issock *et al.*, 2020). The mandatory regulation is disseminated through social norms and becomes one of the educational contents to ensure that residents' proper knowledge of the mandatory status. Therefore, it will encourage the initial stage of participation (Li *et al.*, 2017; Ma *et al.*, 2018; Sujata *et al.*, 2019). In terms of emotional level, according to Ajzen (2005), attitude consists of three domains: cognitive, affective, and conative. The cognitive domain is represented through personal beliefs toward behaviour given through environmental efficacy (Ayob *et al.*, 2017) and personal moral norms (Almasi *et al.*, 2019). The term attitude itself often represents the affective domain, which refers to either like or dislike position (Choon *et al.*, 2017; Heidari *et al.*, 2018; Alhassan *et al.*, 2020). Meanwhile, intention is the conative domain of Attitude (Ajzen, 2005). Therefore, Intention is unified with the attitude component. However, environmental efficacy and personal moral norms should be independent because their existence should show the causal effect of the knowledge domain and other antecedent factors. For environmental efficacy, one of the affecting components is trust to authorities by strengthening the belief of the behaviour's effectiveness to solve environmental problems. However, other affecting factors are understanding the responsibility toward environmental problems both personally and socially, including the authority's responsibility (Mukama *et al.*, 2016; Almasi *et al.*, 2019; Wang *et al.*, 2020b). Thus, the trust of Authorities can be eliminated from the model. By eliminating the factors which are not necessarily required to appear and highlighting the key factors that should be existing as the descriptors of the antecedent factors, the modified model is presented in Fig. 3. The proposed model presented in Fig. 3 offered a more comprehensive view of all key intrinsic-extrinsic factors' relationship and portrayed the intrinsic factors on knowledge level and emotional level, improving the existing models offered by most previous studies. The proposed model also emphasized the importance of knowledge and identified key educational contents as the preceding factors to properly nurture intrinsic factors on an emotional level, which are unnoticed by most of previous studies. The proper improvement of intrinsic factors on the emotional level plays a vital role in nurturing a stable attitude which leads to sustainable changing behaviour. Taking more attention toward all crucial intrinsic-extrinsic factors is expected to give more effective ways to improve residents' behaviour that lead to sustainable participation on waste management. However, the proposed model is not a one-fits-all applicable to any situation because the dominant extrinsic and intrinsic factors may differ from one city to another city. The approaches to share the eight key educational contents should be adjusted to the relevant context to the cities (Knickmeyer, 2019). For instance, the cities experiencing flood disasters can emphasize

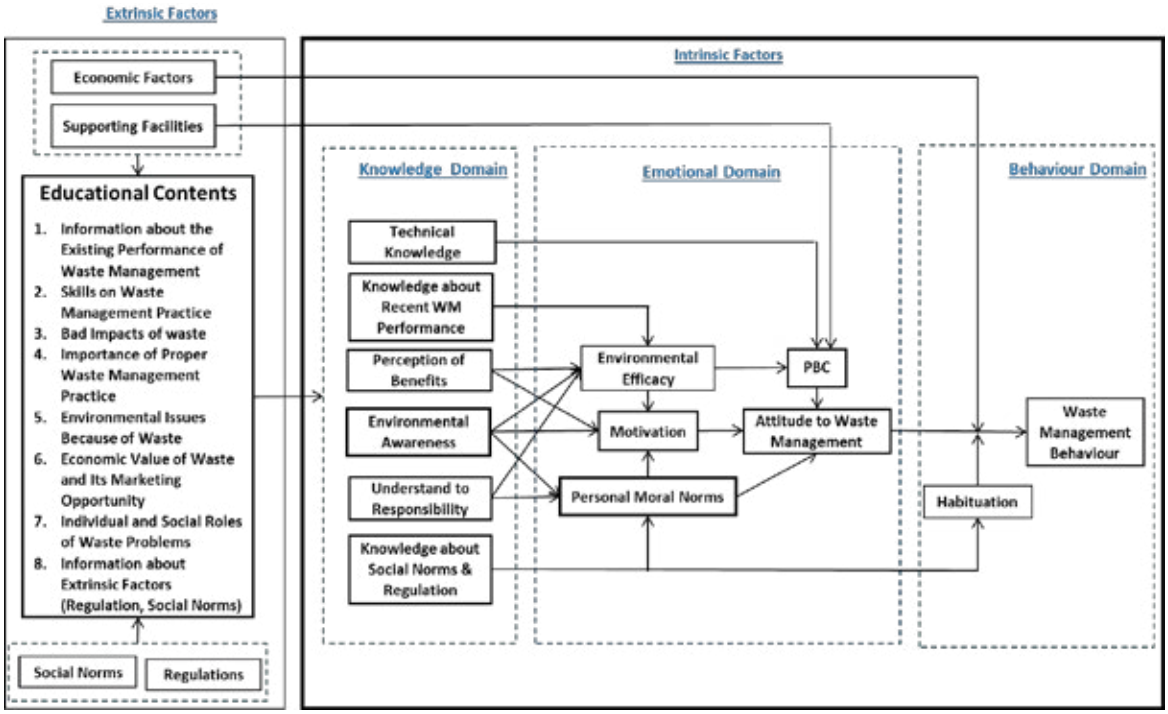


Fig. 3: The proposed model

sharing information about the correlation between their residents' bad behaviour toward waste and the disaster and then offer a solution to solve the flood problems (Lawrence *et al.*, 2020). On the other hand, the cities dominated by low-income residents may emphasize economic benefits by showing the real benefits they can get from the waste. While social norms are not significant in many areas, some other cities with face-saving culture may place social norms as one of the key extrinsic factors. Whilst, communities with religious culture may focus on disseminating religious-based values related to individual and social obligations and environmental conservation, in addition to the other common contents, to encourage changing behaviour. Regardless of the emphasis and approach implemented, the focus should nurture the key intrinsic factors on both knowledge and emotional level to get strong intention. While the extrinsic factors give full support on the intention realization.

RECOMMENDATION

This study has two primary implications for theory and practice. First, the literature review offers different insights in analyzing determinant factors by figuring out causal relationships between extrinsic and intrinsic factors. The proposed model showed the importance of knowledge and emotional domain within intrinsic factors to get sustainable changing behaviour toward waste management. Second, the identification of educational contents must be shared in the resident-based education to nurture key intrinsic factors affecting waste management behaviour, which rarely get attention in the previous studies. Further research may focus on testing the proposed model in the waste management system in specific areas in developing countries. This study is beneficial, especially for local governments or policymakers to refine their programs intended for resident participation improvement on the waste management system.

CONCLUSION

According to the comprehensive literature review conducted, five extrinsic factors play vital roles in cultivating intrinsic factors that significantly affect waste management behaviour. Among the extrinsic factors identified, education is essential

to boost intrinsic factors on an emotional level by improving residents' knowledge of key contents. The knowledge acquisition influences the intrinsic factors improvement on emotional level, leading the expected behaviour. The changing behaviour becomes the indication that the residents willingly participate in waste management. Improving waste management participation by nurturing key intrinsic factors, supported by external factors and habituation, is essential to keep the participation long-lasting. With full support from the antecedent factors, waste management behaviour can be sustainable, which eventually increases the participation rate significantly. However, the impact degree of antecedent factors, extrinsic and intrinsic, can be contextually different from one city to another. Therefore, educational contents' relevance to the residents' environmental problems is highly encouraged to nurture the critical intrinsic factors. The familiarity of educational materials to the residents' waste problems will make the knowledge more impactful. The educational contents are delivered through resident-based education using various techniques and approaches implemented by adjusting the residents' characteristics. The primary requirements for education are durable learning, allow intensive interaction, and enable learning-by-doing to establish new habits and improve performance. The fundamental goal of the education is to enable the transformation of intrinsic factors on the knowledge level to intrinsic factors on the emotional level. Without the existence of intrinsic factors in the emotional domain, the expected behaviour would not be sustainable. If the emotional domain can reach the maximum level, the behaviour can be sustainable even without being moderated by extrinsic factors. However, achieving such a top level of the emotional domain might be hard to reach. Thus, it is recommended to combine extrinsic and intrinsic factors to ensure sustainable resident participation effectiveness. The relationship between key extrinsic and intrinsic factors is presented in Fig. 3.

AUTHOR CONTRIBUTIONS

Sunarti was responsible for searching the bibliography, selecting the relevant references, coding the references, writing the initial manuscript draft, synthesising the manuscript, revising the final manuscript version. J.H. Tjakraatmadja was responsible for conceptualizing the draft, analysing the references' coding, and reviewing the whole manuscript. A. Ghazali was responsible for the work plan preparation, defining the bibliographic search, conceptualizing the draft, review the whole manuscript. B. Rahardyan was responsible for the selecting the relevant references, analysing the coding of the references, and reviewing the analysis in the manuscript.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

ABBREVIATIONS

%	Per cent
3R	Reuse, reduce, recycle
AAA	Ayla aviation academy
e.g.	Exempli gratia/for example
Fig.	Figure
GHG	Greenhouse gas
IGC	International graduate colloquium
MSW	Municipal solid waste
NVIVO R1	A qualitative data analysis software provided by QSR International
LPDP	*Lembaga pengelola dana pendidikan*

PAYT	Pay as you throw
PBC	Perceived behavioural control
PET	Polyethylene terephthalate
PKM	People and knowledge management
SBM	School of business management
UAE	United Arab Emirates
USD	United States dollar
WM	Waste management

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