Developing and validating an instrument of antecedents of solid waste management behaviour using mixed methods procedure

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Abstract: A well-designed strategy for effective solid waste management is a compelling necessity of the modern world. Today, solid waste management is gaining so much of an importance because lack of planning could affect the quality of social, economic and environmental sustainability. Most of the studies have illustrated production of solid waste is due to human needs and desires and the best strategy of solid waste management is to tackle at the point of origin. However, to measure such pro-environmental behaviours among residents, an appropriate and a replicable scale is important. Hence, the purpose of this paper is to explain the processes undertaken to develop a valid instrument to measure the antecedents of solid waste management behaviour. The constructs were assessed using Ajzen's theory of planned behaviour and data was collected from a survey of 233 students belonging to three different colleges of Udupi district, India. The specific validation processes used were: mixed methods approach of content validity, face validity, construct validity, reliability, internal consistency, Cronbach’s alpha correlation coefficient, discriminant validity and convergent validity. Measurement invariance for urban and rural groups was established and the measured model adopted confirmatory factor analysis and structural equation

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PUBLIC INTEREST STATEMENT

Research has illustrated that a sustainable solid waste management system is best strategized when wastes are tackled at the point of origin. To explore such pro-environmental behaviours, a valid and replicable scale is pre-requisite. Therefore, this research used Ajzen’s theory of planned behaviour and mixed methods procedure of content validity for scale development. The reliability and validity findings revealed that mixed methods procedure of content validity is an effective method that draws strengths of both quantitative and qualitative methods. The results obtained from relevant tests showed that the developed scale is reliable, replicable and trustworthy. The specified scale is useful to environmental practitioners, academicians and students since the systematic methods of scale development adopted in this research can be employed at different waste contexts such as E-waste, food waste and plastic waste. Thus this study can be of higher use in environmental protection.
modelling technique for assessing the psychometric properties of constructs. A final and fifth version of questionnaire was designed with 57 items from the initial indicators of 132 items. The findings of this research indicate that psychometrics used in this study are reliable and valid, and can be extended to other research contexts for its higher purpose in environmental protection.

Subjects: Environmental Psychology; Multidisciplinary Psychology; Testing, Measurement and Assessment; Social Psychology; Consumer Psychology

Keywords: Solid waste management behaviour; mixed methods content validity; confirmatory factor analysis; structural equation modelling; instrument design

1. Introduction
Since the era of globalisation came into existence, world is facing constant environmental ramifications due to urbanisation and over-consumerism patterns. Of many environmental problems, irrational disposal of Solid Waste (SW) is considered to be the major problem, since it could affect the stability of environmental and social life of a society (Baud et al., 2001; Jekria & Daud, 2016; Zurbrügg et al., 2012). From the early phase (Hopper & Nielsen, 1991) till recent time (Ma et al., 2018), numerous studies have been conducted in the domain of SW. There is a valid reason for these studies in acknowledging the complex nature of waste disposal patterns which are produced in an ever increasing order. This environmental problem profoundly relates to Indian scenario where heaps of wastes are seen in almost every public place, causing serious damage to natural resources, public health and safety of citizens. It is expected that the country would generate 300 million tonnes of SW by the year 2047 from the current generation of 48 million tonnes per year (Pappu et al., 2007). It is also anticipated that the land required to dispose wastes would be 169.6 km² as against 20.2 km² i.e. eight times more than was needed during 1999 (Central Pollution Control Board, India, 2019). Owing to these alarming statistics, statutory bodies in the nation have launched waste management programs such as clean India mission and plastic-free campaigns. However, a common understanding among public is; pro-environmental programs are comprised of top approaches where municipal corporations have the sole and higher responsibility in transporting garbage, cleaning streets, clearing plastics and recyclables from public spots. Although, very few individuals indulge in Solid Waste Management (SWM) methods, some often fail to choose those behaviours which lessen their impact on environment. This wide disparity in attitudes, beliefs and actions among citizens opens up a scope for scrutiny within the domain of environmental psychology to explore the antecedents of behavioural aspects and causal relationships between psychological variables. Obviously, landfills are the hazardous ways of waste disposal method due to its potency to produce methane gas and damage our ecosystem (Themelis & Ulloa, 2007). Also, continuation of landfills as a waste treatment option is not only a pressing threat to the nation but it possesses environmental risk at global level. In that view, investigation of waste behaviours among residents is an essential strategic step in environmental planning and management science. This root-cause analysis approach to understand the dynamics of variables that overlays or underplays SWM Behaviours (SWMB) amongst citizens is need of the hour, since it paves a path for national development in terms of environmental, social and economic sustainability.

In order to capture the psychological characteristics of individuals in applied psychology and behavioural science, self-administered questionnaires come as handy, practical and a preferable tool (Cook & Wolf, 1999; Curkovic, 2003; Parsian & Dunning, 2009). The importance of scale development and validation of self-administered questionnaires have been reported in medical, business management, engineering and public health domains (Dagger et al., 2007; Kendall & Bloomfield, 2005; Scandura & Williams, 2000). However, such validated studies are found to be extremely scarce in environmental psychology research. Also, to our knowledge that not many researchers have devoted attention and time to address the importance of scale
development and validation process of self-administered questionnaires; particularly in examining the antecedents and inter-relationships of SWMB, both in international and national context. Such studies are important in environmental psychology since they significantly influence and contribute to the quality content of research work in at least six ways as follows.

First, most of the behavioural science problems deals with the utilization of theories to develop conceptual frameworks. This is because an established theory enables a researcher to avoid implicit assumptions and provides a basis for explicit causal pathway explanations of a research problem (Davis et al., 2015; Michie & Abraham, 2004; Michie et al., 2015). In that process of meeting research objectives, a logical structure and reasoning arguments are obtained for those studies in which questionnaires undergo validation process in a scientific manner by eliminating confusions about research constructs, and measures those items that need to be measured. Thus, those questionnaires which undergo validation process have a better ability to capture information as compared to those which do not follow the validation process (Breen, 2019; Morgesan & Humphrey 2006; McKenzie, 2011). Second, such validation methods of questionnaires are not only useful in mitigating environmental problems that the world is facing today, but it also enhances the quality of environmental solutions that researchers provide to save environment by creating a forum to exchange innovative thoughts about different techniques that are related to specific subject aiding in improvement of research work (Bruce & Fries, 2003; Evers et al., 2016). Third, when questionnaires are scrutinized through the formal methods of expert opinions of academia and senior consultants of reputed bodies, items undergo purification process in which scales are either eliminated or rectified. The validation of developed items in the form of rating, suggestions and guidance of experts due to their expertise in respective fields enhances the item development, thus directly influencing the research output (Cade et al., 2002; Sasaki et al., 1998; Spector, 1992). Fourth, environmental psychology relies upon both experiences and systematic theorizing of concepts to eliminate errors, and hence when questionnaires are subjected to evidence-based techniques, irrelevant information and similar concepts are omitted, resulting in quality survey questionnaire (Chatterji, 2002; Pluye et al., 2014). Fifth, it aids a researcher by indicating whether the defined constructs framed for a particular study are functional or deficient; thus saving time and avoiding a stage of drawing invalid conclusions that later have to be rejected due to false and misleading data (Churchill Jr & Peter, 1984). Sixth, as science progresses, novel research questions and ideas demand new scale development and such studies help future researchers, teachers and students to acquire technical knowledge in scale development and empirical validation process; allowing them to conduct more studies in methodical and scientific ways by setting organised set of activities. Considering these grounds, we present this study to explain the procedures undertaken in developing and validating SWMB Questionnaire (SWMBQ) for its higher use in environmental protection. This paper is not a review paper, but it is purely a research article that deals with the process of designing and validating an instrument for the purpose of primary data collection of our ongoing study. Also, since this research mainly emphasises on instrument development and validation procedures of SWMBQ, an elaborate literature review of the factors that form SWMB and related hypothesis development is not presented in detail. However, a brief explanation of the conceptual development is presented in the following sections.

2. Operationalization of TPB
The exercise of systematic literature review to understand the status of existing literature revealed that the Theory of Planned Behaviour (TPB) by Ajzen (1991) has been extensively used as an effective theoretical framework to explore the behavioural aspects of waste management, as compared to other contemporary theories (Raghu & Rodrigues, 2020). TPB, an extension of theory of reasoned action (Ajzen, 1985) is postulated on the assumption that most human behaviour is based on the result of individual’s belief, attitude, Subjective Norms (SN), Perceived Behavioural Control (PBC) and intention to undertake a particular behaviour and the ability of an individual to take conscious decision about it (Harm et al., 2015). SN relates to an individual’s perception of social pressure from others who are close to them such as family,
friends, and colleagues, who can influence them to behave in an eco-friendly manner or not (e.g., “most people who are important to me think I should recycle wastes”) and PBC refers to the perceived facility or difficulty in performing the behaviour and perceived power of these factors to take up a task (e.g., “waste separation is easy for me”). While SN influence a person’s intention to perform a behavior, behavioral belief forms the attitude of an individual (Ajzen, 1991). According to Ajzen (1991), it is hypothesised that intention is the key and immediate antecedent of behaviour and PBC is the second determinant that produces mediating effects on behaviour. The combination of attitude, SN and PBC leads to the formation of intention-behaviour phase. As a general understanding, the more favourable attitude and SN with high level of PBC, the stronger is the relationship between intention-behaviour. Belief is considered to be the value orientations that an individual possesses towards the consequences of an issue (Ajzen, 1991, Stern, 2000). Although, TPB has been widely applied, tested and accepted across the different parts of the world, interesting fact is that no two studies have been reported to be similar. Furthermore, it is acknowledged that scientists share similar views on environmental degradation, but have reported varied results by incorporating different research frameworks, tools and techniques to explore the parameters of SWMB. Considering the effectivity, popularity and suitability of the current research scenario, this research utilizes TPB to design and validate an instrument to investigate the belief-behaviour link of SWMB.

The concept of SWMB is involved with a set of actions taken by individuals, communities and societies who themselves are considered as actors in minimizing wastes (reduce), use of goods that can still be used (reuse), utilize wastes to usable form (recycle) and waste disposal in a logical manner (Hänsch et al., 1995; Pongrác, 2002). Literature highlights that waste is produced due to human needs and desires (Stern, 2000) and several extrinsic and intrinsic factors play a pivotal role in exhibiting a SWMB. Since socio-psychological models allow addition of more variables to the primary model while evaluating a complex problem such as SWM, previous studies have added several factors to this intention-based framework. Some of the added variables are knowledge, self-identity, compassion towards environment, availability of recycling bins, kerbside recycling options, environmental instruments and municipal encouragement (Daneshvary et al., 1998; Izagirre, 2015; Mahmud & Osman, 2010; Pakpour et al., 2014; Zhang et al., 2015). Although some studies have agreed to a set of proposed hypotheses, some have disagreed in the context of evaluating the TPB. Hence, in the view of progressive research a conceptual model based on TPB with 15 constructs was developed to explore the waste belief—waste behaviour link, and to comprehend how and why wastes are produced. Since waste hierarchy beliefs are the key factors to be scrutinized in our ongoing research, we framed: Solid Waste Management Belief (SWMF) with Waste Reduction Belief (WDB), Waste Reuse Belief (WUB), Waste Recycling Belief (WCB) and General Disposal Belief (GDB); Solid Waste Management Attitude (SWMA) with Environmental Knowledge (ENK) and Moral Obligation (MOR); Solid Waste Management Intention (SWMI) with Subjective Norms (SN), Perceived Behavioural Control (PBC), Community Concern (COC), Community group (COG) and Awareness (AWA) and SWMB as shown in Figure 1. Research constructs, operational definitions and research hypotheses pertaining to SWMBQ were clearly defined and research methodology for the primary empirical research was also formulated. These procedures were crucial since our research is about exploring the antecedents of SWMB through scientific techniques of sequential explanatory design of mixed methods approach.

3. Research aim and research question
The aim of this research is to develop an instrument that can be used to study the antecedents of SWMB for the purpose of demonstrating the empirical inter-relationships of waste behavioural patterns among youths using TPB. The research question is: can a scale be developed, tested and validated that determines the SWMB amongst youths.

4. Methods
Following procedures were conducted to develop and validate the SWMB instrument.
4.1. Phase 1: scale development

4.1.1. Stage 1: item collection

Step 1: While developing the SWMBQ, deductive method of scale development was adopted to collect a pool of items for each construct. This method is chosen because an existing scale with theoretical underpinnings has abilities to exhibit empirical results. Since this method will be based on the accumulation of the existing items' knowledge (Idaszak & Drasgow, 1987), items were chosen from Scopus indexed and ISI web of Science journals to meet the quality content of this research. Items were collected from waste behaviour studies that best suited our model, and which included from behavioral studies such as food separation, waste management, waste minimization, textile, composting and garden, garden engagement, waste sustainability, community-based activities, reduce, reuse and recycling and green practices.

Step 2: In the second stage, extracted studies were scrutinized for quality assessment. While there are no standard methods available for choosing a particular article for item selection, researchers opine that items chosen should be context-based with appropriate research design, and items should be able to measure the research constructs that is intended to be measured (Nunnally & Bernstein, 1994). Hence, to gather the best possible indicators (from Scopus indexed and ISI web of science articles), we selected items from those studies which had clear description of research objectives, research aim, research methods and research findings relevant to the current study. Some articles had specified the methods of item reduction such as pilot study (for primary data collection) and this was helpful in item selection that best suited our SWMB constructs.

Step 3: While conducting the previous step, we came across few studies from the top-quartile journals with high citation numbers. However, questionnaires were unavailable either in journal articles or in other databases. Hence, formal emails were sent to those authors seeking for questionnaires that were previously used in their studies. Of seven emails that we sent, questionnaires were received from three experts, which added to the pool of items that had been collected before.

Step 4: Once questionnaires were received from experts, each item was reviewed back and forth several times to select the best reflected item that suited the research construct definition. In the process of compilation, we initially collected 132 items, of which few constructs had more than 12 items and few had less than 6 items. Minute detailing of each item was taken into consideration to avoid similar concepts, overlapping structures, wrong phrases and negatively worded sentences. This stage is considered to be vital since it has potential to avoid factor structure problems that
may occur in later stages (Kortte et al., 2007). From a total of 132 items, 16 items were eliminated based on overlapping and similar concept, which led to an elaborated compilation of 116 items.

**Step 5:** After item compilation, a preliminary questionnaire was prepared in Microsoft Word document apart from a brief SWM introduction sheet. A total of 116 items including 6 demographic items were incorporated into this preliminary questionnaire. To examine all the independent and dependent variables that affect SWMB, the developed preliminary questionnaire was divided into five main sections, i.e., demographic details, SWMF, SWMA, SWMI and SWMB. Each construct was designed to have a minimum of five to maximum of eleven questions and all items used 5-point Likert scale from positive to negative, i.e., 1 = strongly disagree to 5 = strongly agree. A Microsoft Word page was created and this formed the first version of our SWMBQ.

### 4.1.2. Stage 2: content validity of SWMBQ

Content validity, referred as theoretical analysis (Boateng et al., 2018) and logical validity (Newman et al., 2013), is the fundamental step of scale validity. It is conducted to assess the domain of interest by using the measures of relevance, and to which the items in survey instrument reflect the construct and content for a purpose (Boateng et al., 2018; Haynes et al., 1995; Penny et al., 2009). It therefore ensures to measure the consistency of the theoretical realm of constructs and captures the elements of those constructs by eliminating irrelevant and non-cohesive items. Although several methods have been developed to measure content validity, a general opinion amongst researchers’ fraternity is that the more type of validity tests of an instrument, the greater is the trustworthiness of the instrument (Anderson & Gerbing, 1991; Haynes et al., 1995; Nunnally & Bernstein, 1994). In this context, in the progress of assessing the alignment of SWMB items, we adopted mixed method content validity approach suggested by Newman et al. (2013). The chief advantage of using this method is that it utilises the strengths of both quantitative and qualitative techniques of content validity. A pragmatic and dynamic in nature, this method aims for item purification through robustness of triangulation process. It enhances the research outcome by its versatility in gathering materials for the purpose of assessing the intended item alignment and item refinement (Neumann et al., 2007; Tashakkori & Teddlie, 2009). Further, to our knowledge, this method has not been used in previous environmental psychology and environmental management studies. Hence, we undertook following two stages to accomplish mixed method content validity procedure.

#### Step 1: Quantitative Procedure

In this stage, an attachment about a brief introduction of the project, purpose of the study, aim of the research, concepts of items, and rating options were developed in the view of availing experts’ quantitative feedbacks. Further, as suggested by Newman et al. (2013), operational definitions of study variables and a table of specification detailing the concepts, items and content areas were added to the first version of SWMBQ. A feedback column was incorporated and experts were asked to rate the alignment of each item in four ways of relevance, representativeness, clarity and specificity. (1) For relevance, experts were asked whether the item was appropriate to measure the outcome of the concept SWMB (e.g., experts were asked whether “I intend to separate wastes at home on a regular basis” was appropriate to capture SWMI activities). To rate this, response options 1 = not at all relevant (low), 2 = somewhat relevant (medium), and 3 = clearly relevant (high) were provided. (2) For representativeness, experts were asked whether the items were representing all of the parameters to be measured within that construct and thus affecting the corresponding levels of research outcomes (e.g., experts were asked if proposed items were representing all dimensions of the level of SWMA). For this, three rating options were given such as 1 = not at all representative (low), 2 = somewhat representative (medium) and 3 = clearly representative (high) were included. (3) For clarity, experts were asked whether the items were clear with no ambiguity and no double-barrelled items so that the respondent finds it easy in answering. For this, three rating options were provided 1 = not at all clear (low), 2 = somewhat clear (medium), 3 = very clear were (high) were used. (4) For specificity, experts were asked
whether the items were specific to measure the levels of each item. For this again three rating options of 1 = not at all specific (low), 2 = somewhat specific (medium), and 3 = very specific (high) were included in SWMBQ. This became our second version of SWMBQ. The evaluation form along with the attachments (mentioned above) were sent to 18 experts from academia and industries who possessed relevant experience in SWM field. Responses were received from five experts, three peers working in international universities and two consultants working in national industries. The scores received from these experts were added and the average agreement of experts’ judgement was converted into average agreement percentage. Following this, items which had rating below 90% were assessed individually and were deleted. Some items were recommended for modifications and those were included as per experts’ comments. On the whole, out of 116 items, 55 items were retained, 35 items were modified and 26 items were deleted making a total of 90 items (Table 1), which formed the third version of SWMBQ.

Step 2: Qualitative Procedure

In order to collect the qualitative feedbacks, third version of SWMBQ was sent to 10 experts, and reply was received from 5 peers, all working as academicians at international universities. Once experts’ suggestions were received, for the sake of eliminating confusion we divided all responses into qualitative general opinions (Table 2) and qualitative specific comments (Table 3). After considering the feedbacks, no items were deleted, but changes were incorporated by rephrasing few sentences. Hence, the fourth version of SWMBQ was developed with 90 items, of which 6 items had demographic details and 84 items were used for hypothetical research model.

Step 3: Face validity

Face validity is conducted to understand the appropriateness and content relevance of developed items as they appear in terms of feasibility, easiness and readability for respondents (Holden, 2010).

| Table 1. Summary of quantitative content validity results |
|--------------------------------------------------------|
| **Construct** | **Initial no of items** | **Retained** | **Modified** | **Deleted** | **Total no of items carried over to phase 2** |
| Demographics  | 6                        | 5            | 1            | 0           | 6                                      |
| SWMF          | 6                        | 4            | 1            | 1           | 5                                      |
| WDB           | 6                        | 5            | 0            | 1           | 5                                      |
| WUB           | 5                        | 5            | 3            | 0           | 5                                      |
| WCB           | 10                       | 10           | 4            | 0           | 10                                     |
| GDB           | 6                        | 3            | 2            | 1           | 5                                      |
| SWMA          | 5                        | 3            | 2            | 0           | 5                                      |
| ENK           | 10                       | 4            | 4            | 2           | 8                                      |
| MOR           | 9                        | 3            | 2            | 4           | 5                                      |
| SWMI          | 6                        | 4            | 1            | 1           | 5                                      |
| SN            | 8                        | 3            | 3            | 2           | 6                                      |
| PBC           | 9                        | 3            | 2            | 4           | 5                                      |
| COC           | 8                        | 4            | 3            | 1           | 7                                      |
| COG           | 8                        | 2            | 2            | 4           | 4                                      |
| AWA           | 7                        | 2            | 3            | 2           | 5                                      |
| SWMB          | 7                        | 2            | 2            | 3           | 4                                      |
| **Total**     | **116**                  | **55**       | **35**       | **26**      | **90**                                  |
Table 2. Collective qualitative general comments by experts

| General opinions of experts |
|-----------------------------|
| (1) You have an interesting questionnaire regarding recycling. However in my opinion you have to modify and rephrase some sentences. Too many questions have problems as you should know. |
| (2) You need to view my comments and suggestions to amend the items through track changes. All questions are valid except SWMB-behavioural aspects which should be modified to best suit the target group. |
| (3) All items are very much suitable. But in my opinion you should first brief the meaning of waste management as some people may not understand. You can send a covering letter and importance of this research, aiding them to answer. |
| (4) Confidentiality information such as name, telephone number, etc., need not come in demographics page. |
| (5) Am glad that you are interested in this topic as well as my paper. The issue is extremely important and not outdated. I used various methodology to tap needed info and data; not only questionnaires sent to community people, but also checking recording book of the group, focus group meeting, interview with some key informants and field observation. |

Table 3. Collective qualitative specific comments by experts

| Section | Comments |
|---------|----------|
| General | • Usually the name section is not included in the questionnaire to protect the confidentiality of the respondent.  
• The questionnaire should start with brief introduction of six to eight sentences of the research for respondent’s understanding. |
| Demographics | • Q3—Be specific. The number of family members, including the respondent.  
• Q4—Others—specify can be added.  
• Q5—Location can be added to ensure whether the respondent belongs to same county.  
• Q6—This will be of their family background? |
| SWMB | • Item 1—Start with an active sentence, “I believe …”  
• Item 2—You give the respondents to choose, my suggestion is just use either one, good or bad  
• Item 3—Be specific, what claim? And start the item with an active sentence.  
• Item 5—Be specific. Separation of what? Separation of solid waste?  
• Item 6—My suggestion, rephrase the sentence to make it clear to the reader.  
• Item 6—My suggestion is to add “environmental activity” |
| WDB | • Item 1—Start with an active sentence.  
• Item2, 3 & 4—These two items here are measuring attitudes towards the concept of B1. Is that your objective for this section?  
• Item 5—Start with active sentence and sentence can be rephrased.  
• Item 6—This item is measuring action. Is that what you are measuring? |

(Continued)
| Section | Comments |
|---------|----------|
| WUB     | - Item 2—Add excessive garbage.  
          - Item 5—This item is not clear. Rephrase the sentence to make understandable.  
          - Item 2 & 3—These two items measuring attitude. Change phrases according to belief concept. |
| WCB     | - Item 2, 3, 4, 5—Change to active sentence  
          - Item 4—This item is not clear. Rephrase the sentence.  
          - Item 7—What do you mean by easy.  
          - Item 8—Change it into environmental quality rather negative word.  
          - Item 9—Both terms “sensible” and “hygiene” should be split into separate question |
| GDB     | - None |
| SWMA    | - Item 2—Avoid using “We”. Because the word “we” in this item is ambiguous. Who is “we”?  
          - Item 2—We or I  
          - Item 5—Don’t use abbreviations. Make SWM full. Nice! This section is clear in its language and gauging actions and perceptions. |
| ENK     | - Item 2 to 5—Change to active sentence.  
          - Item 2—Make it full form for SWM.  
          - Item 3—in what way “serious”.  
          - Item 3—change the sentence to avoid confusion.  
          - Item 6—what species? Flora and fauna?  
          - Item 6—Be specific about species. |
| MOR     | - Item 1—Relieve- Awkward choice of word here.  
          - Item 1—change as “towards environment problems”.  
          - Item 3—change to active sentence. |
| SWMI    | - Item 1—What do you mean by “regular basis”  
          - Item 1—Can be changed . . Daily or regularly. |
| SN      | - Item 1—You should give the definition and example of SWM behaviour to the respondent. The information can be included in the introduction of this questionnaire. |
| PBC     | - Item 2—choose one to avoid confusion.  
          - Item 2—Both “knowledge” and “skill” are different. So cannot be included in a single question.  
          - Item 3—Is not suitable to use this because there is a choice. |
| COC     | - Item 2—make positive phrase  
          - Item 4—Cannot use abbreviation unless it is specified in the questionnaire before. |

(Continued)
Table 3. (Continued)

| Section | Comments |
|---------|----------|
| COG     | • Item 2—NGO meaning can be elaborated at the beginning.  
|         | • Item 2—abbreviation NGO? |
| AWA     | • Item 2—Item has ambiguity. Can be rephrased.  
|         | • Item 3—Do they know?  
|         | • Item 3—What waste management principles?  
|         | • Item 4—Add waste management awareness instead of just awareness. |
| SWMB    | • Item 1—Can you define wastes as well? Food, clothes, paper ...  
|         | • Item 2—What is the example of waste management behaviour? Be specific. Different respondent might have different idea on what is waste management.  
|         | • Item 3—Emphasise on waste management actions. |

2010; Wheeler et al., 1999). It evaluates the appearance of a questionnaire superficially in terms of design and usability rather than reliability. Although some researchers express that face validity is the easiest but weakest form of validation process and its functionality is questionable (Nevo, 1985), this type of validity is considered to be an important step in behavioural science studies since an assessment of acceptability of a scale is crucial for its utility to serve higher purpose. It also eliminates the biased estimates and systematic errors of an instrument (Fowler Jr, 1992). Hence, we undertook this procedure as an extension of previous steps to gather the actual experience of easiness/difficulty of respondents in answering the fourth version of SWMBQ. For this purpose, an evaluation form was developed to assess the (1) clarity of sentences (2) layout and formatting style (3) degree of understanding (4) content of the questionnaire and (4) acceptance of text. A feedback column was also added to this evaluation form so that the respondents can provide their comments. A complete kit of questionnaire, an information sheet about SWM and face validity evaluation form was handed over to 38 students belonging to Nursing, Arts and Science streams. These respondents were randomly chosen during our visits to their respective colleges. The options for scaling used Likert scale of 1–4, with 1 = strongly agree, 2 = agree, 3 = disagree and 4 = strongly disagree. Responses were collected after one week and it was found that none of the respondents faced any problems in understanding the content. Thus, a total of 90 questions were carried out for the next phase, i.e., data collection.

4.2. Phase 2: data collection

This research used convenience sampling method to collect samples from students of age group 18–22 years. The sampling unit chosen was Udupi district, Karnataka state, India. Since students are future faces of any country and their responses to SWM issues at their formative stage of professional studies would reflect the attitudes and behaviours that they had inculcated throughout their childhood, we approached six different professional colleges belonging to different streams. We utilised both means of survey administration, i.e., pen/pencil questionnaire form and web-based questionnaire form. The former method was used to collect data from three rural colleges where a complete kit of self-administered SWMBQ and a brief description sheet of SWM was handed over in person. The latter method was used to collect data from three urban colleges where students were asked to fill up the web-based data collection page. The web page was developed in such a way that the respondents had an option of getting back to the page that was left of and complete the survey, if they were unable to fill the questionnaire at one time. Three
week time was given to both type of survey respondents and collection of both methods of survey administration yielded us a total response of 515, of which 233 responses were of usable form.

4.3. **Phase 3: data analysis**

4.3.1. **Stage 1: descriptive analysis**

The first analysis that was undertaken after data pooling procedure was the examination of sample characteristics. This stage is often regarded as primary and fundamental step in data analysis since the survey examination can explain and summarize the characteristics of respondents in a meaningful way. Since the raw data cannot convey the features of the study data, descriptive analysis is an effective method of describing the data and analyses whether the collected data is representative of the larger target population (Holden, 2010). Moreover, sampling frame should be comprised of composite profile with fair distribution of sample characteristics to avoid possible bias. Hence, demographic details of respondents were analysed using mean type of statistical measures. Mean is the most widely applied method for describing a central tendency to represent the central gravity of distribution. Since mean can compare different groups and aid in computing further statistics, we used SPSS IBM version 19 to calculate the arithmetic average of each component of respondents’ demographic details.

4.3.2. **Stage 2: confirmatory factor analysis**

For assessing the psychometric properties of SWMBQ, this research adopted Confirmatory Factor Analysis (CFA). The reason for choosing CFA as compared to Exploratory Factor Analysis (EFA) is that this study is theory driven and intends to assess and validate the measurement properties of a construct in terms of its consistencies with our understanding of the nature of constructs. Since the study uses previous empirical research to determine the relationships between observed variables and their latent constructs, CFA is better suited as against EFA where underlying factor structure needs identification without preconceived structure of a construct and its results (Gerbing & Hamilton, 1996; Harrington, 2009; Suhr, 2006). Another attractiveness of CFA is that it avoids difficulty factors and poor item distributions during development of scales either by item reduction or item modification (Bollen & Ting, 1993; Byrne, 1988; Hurley et al., 1997; Schreiber et al., 2006). In addition, CFA approach is suitable to current study which focuses on estimating the relationships between latent constructs by retaining only functional and internally consistent items on the basis of systematic assessment procedures.

4.3.3. **Stage 3: structural equation modelling—PLS 3.0**

Finally, for inferential statistics analysis, Structural Equation Modelling (SEM) Smart-PLS version 3.0 that utilizes CFA to measure the components was employed. The logical reasons for choosing SEM-Smart PLS as compared to other software programs are: (i) its ability to analyse multivariate data by explaining both direct and indirect effects of interrelated variables through elaborated statistical analysis (Hoyle, 2000) (ii) it can specify, estimate, assess and present models in an intuitive path diagram to indicate hypothesized interrelationships among variables (Chou et al., 1996) (iii) its statistical efficiency and usefulness of model fit output during hypothesis testing, which otherwise is not possible in factor analysis/principal component approach (Curkovic, 2003; Mosconi et al., 2008) (iv) It can derive the best indicator of latent constructs through the process of factor loadings, unique variances and modification indices, and validates an instrument in measurement model which is a fundamental analysis to structural model (v) its statistical power in terms of structural and measurement model with the sample size of 200 (Hair Jr et al., 2014; Ifinedo, 2018).

4.3.3.1. **Step 1: measurement invariance of composite models.** Before pooling the samples from traditional and web-based surveys, it is important to explore the structural variance of multivariate data. This is because, a lack of Measurement Invariance (MI) may lead to improper validity results and conclusions since the meanings of constructs that respondents perceive may vary across
groups. Ensuring the measured latent construct that has the same purpose of measuring intended content across different groups, and establishment of MI is one of the prerequisites of data pooling. Therefore, this became our first stage of data analysis. We conducted MI using multigroup CFA. Multigroup CFA is an expansion of typical CFA that evaluates single model fitting to a data set by dividing the data set into groups (Chen et al., 2005; Cheung, 2008; Vandenberg & Lance, 2000). Its advantages to determine the model fit for each group separately, and then comparing multi-groups between each group has allowed researchers to examine whether respondents from different groups interpret the same measure in a conceptually similar way. Since SEM-PLS version 3.0 has robust output features as compared to regular common factor technique, we adopted Measurement Invariance of Composite Models (MICOM) procedure to establish invariance of composite models and pool the data. MICOM is a new feature and is gaining popularity in management discipline for its powerful efficiency of analyzing multi groups' data pertaining to various countries, societies and culture. It tests if the predefined groups have statistically significant differences in group-specific estimations such as outer loadings, outer weights and path coefficients through permutation method. The three steps of MICOM are: (1) configural invariance (2) compositional invariance, and (3) the equal means of values and variances. Since it is a precondition to establish each step, it becomes necessary to assess the quality of composite mean values as recommended by Henseler et al. (2016). The three-step hierarchical levels that are interrelated are shown in Figure 2.

4.3.3.2. Step 2: assessment of measurement model. From an operational perspective of SWMB model, construct validity, convergent validity, discriminant validity, criterion validity and reliability were considered to be important for assessing the measurement properties of all constructs. Accordingly, once data were pooled, a measurement model was formulated and each variable was subjected to validity and reliability measures through iterative process. The primary purpose of this step was to attain unidimensionality of multiple item constructs by eliminating inappropriate and unreliable items.

5. Results

5.1. Stage 1: Measurement invariance of composite models

In Step 1, three aspects of configurational invariance assessment, i.e., setting up of measurement models, data treatment for model estimation using full data set and algorithm settings for all model estimations were achieved. Since SEM-PLS version 3.0 has built-in algorithm settings, we conclude this step is established.

| Step 1: Configural invariance? | Yes | No |
|--------------------------------|-----|----|
| Step 2: Compositional invariance? | Yes | No |
| Step 3: Equal mean values and invariances? | Yes | No |

**No measurement invariance:**
The composite does not exist in all groups

**No measurement invariance:**
The composite is formed differently across groups

**Partial measurement invariance:**
The standardised coefficients of the structural models can be compared across groups

**Full measurement invariance:**
The data of different groups can be pooled
In Step 2, permutation test was conducted to assess the compositional invariance which requires that correlation $c$ should be equal to 1 (J. Hair et al., 2017). In addition, $p$ value of permutations should not be significant which means that $p$ value should be >0.5. Since MICOM allows to conduct the computations of Step 2 and Step 3 simultaneously with more number of permutations, we opted for 5000 permutations. Table 4 shows PBC of 0.998 which is very close to 1 has the lowest $c$ value as compared to all composites of SWMB model. Therefore, we conclude that compositional invariance has been established for all the elements of SWMB composites model.

In step 3, we assessed the composites equality across groups by mean values and variances that were set up for the measurement of SWMB model. The results of 5000 permutations shown in Table 5 and Table 6 revealed that the mean value and the variance of composites of Group 1 did not significantly differ from Group 2. Since the mean original difference and variance original difference falls between 2.5% and 97.5% boundaries, we conclude that full invariance has been established for the two groups of survey data. This means all composite models of SWMB construct carried almost similar meanings that are supposed to be measured in relation to the measurement of constructs. Since the composites in both groups are almost identical, the samples from both surveys were pooled in the view of generalizing the concept of SWMB, which would be possible by increasing the statistical power of larger sample size.

### 5.2. Stage 2. sample characteristics

The findings of sample profile are shown in Table 7. The highest response was obtained from the age group of 19 years (26.6%) followed by 18 years (20.6%), 20 years (18.8%), 22 years (17.2%) and 21 years (16.8%). In terms of gender, responses from male students (57.9%) were higher than female students (42.1%). Education-wise, the majority of students were from engineering (42.1%) followed by medical (18%), nursing (14.2%), arts (8.2%), commerce (6.4%), science (6.8%) and Sanskrit (4.3%). In terms of place of living, urban residents (53.6%) were of majority as compared to rural residents (46.4%). Maximum respondents from middle-class group were higher (42.1%), followed by lower class group (26.2%), upper middle-class group (15.9%), rich class (10.3%), below poverty group (3.4%) and lower middle-class group (2.1%). As it can be observed, the demographic characteristics denote a fair representation of sample from selected population.

| Composite | Original Correlation | Correlation Permutation Mean | 5.0% | Permutation p-Values |
|-----------|----------------------|-----------------------------|------|---------------------|
| SWMF      | 1.000                | 0.999                       | 0.997| 0.670               |
| SWMA      | 1.000                | 0.999                       | 0.996| 0.850               |
| SWMI      | 1.000                | 1.000                       | 1.000| 0.420               |
| SWMB      | 1.000                | 0.999                       | 0.997| 0.860               |
| WDB       | 1.000                | 0.999                       | 0.995| 0.890               |
| WUB       | 1.000                | 0.999                       | 0.997| 0.950               |
| WCB       | 1.000                | 1.000                       | 0.999| 0.950               |
| GDB       | 1.000                | 0.999                       | 0.997| 0.840               |
| ENK       | 1.000                | 0.999                       | 0.996| 0.880               |
| MOR       | 1.000                | 1.000                       | 1.000| 0.130               |
| SN        | 1.000                | 0.999                       | 0.999| 0.930               |
| PBC       | 0.998                | 0.995                       | 0.983| 0.600               |
| COC       | 0.999                | 0.989                       | 0.972| 0.960               |
| COG       | 1.000                | 0.996                       | 0.986| 0.980               |
| AWA       | 1.000                | 0.997                       | 0.991| 0.960               |
| Composite | Mean—Original Difference | Mean—Permutation Mean | 2.5% | 97.5% | Permutation p-Values |
|-----------|--------------------------|-----------------------|------|-------|---------------------|
| SWMF      | -0.049                   | -0.005                | -0.125 | 0.089 | 0.470               |
| SWMA      | 0.002                    | -0.005                | -0.108 | 0.120 | 0.990               |
| SWMI      | -0.052                   | 0.004                 | -0.101 | 0.106 | 0.480               |
| SWMB      | -0.003                   | -0.008                | -0.142 | 0.099 | 0.970               |
| WDB       | 0.007                    | -0.004                | -0.126 | 0.095 | 0.910               |
| WUB       | -0.005                   | -0.013                | -0.116 | 0.086 | 0.910               |
| WCB       | 0.009                    | 0.001                 | -0.141 | 0.101 | 0.910               |
| GDB       | -0.017                   | -0.001                | -0.143 | 0.120 | 0.850               |
| ENK       | -0.035                   | -0.005                | -0.149 | 0.094 | 0.550               |
| MOR       | 0.029                    | 0.000                 | -0.136 | 0.128 | 0.640               |
| SN        | -0.024                   | -0.004                | -0.123 | 0.154 | 0.770               |
| PBC       | 0.003                    | -0.003                | -0.139 | 0.103 | 0.448               |
| COC       | -0.061                   | -0.003                | -0.165 | 0.117 | 0.360               |
| COG       | 0.017                    | 0.001                 | -0.124 | 0.121 | 0.790               |
| AWA       | -0.057                   | 0.004                 | -0.148 | 0.126 | 0.450               |
| Composite | Variance—Original Difference | Variance—Permutation Mean Difference | 2.5%  | 97.5%  | Permutation p-Values |
|-----------|-------------------------------|--------------------------------------|-------|-------|----------------------|
| SWMF      | -0.074                        | -0.004                               | -0.210| 0.137 | 0.240                |
| SWMA      | 0.059                         | 0.013                                | -0.157| 0.216 | 0.590                |
| SWMI      | -0.044                        | 0.000                                | -0.267| 0.186 | 0.620                |
| SWMB      | -0.025                        | 0.001                                | -0.190| 0.122 | 0.770                |
| WDB       | -0.001                        | 0.010                                | -0.182| 0.248 | 0.400                |
| WUB       | 0.008                         | -0.015                               | -0.205| 0.163 | 0.930                |
| WCB       | 0.015                         | 0.016                                | -0.227| 0.199 | 0.850                |
| GDB       | -0.100                        | -0.001                               | -0.188| 0.179 | 0.290                |
| ENK       | -0.029                        | 0.013                                | -0.241| 0.258 | 0.830                |
| MOR       | 0.043                         | -0.005                               | -0.216| 0.269 | 0.700                |
| SN        | -0.025                        | -0.007                               | -0.216| 0.228 | 0.850                |
| PBC       | -0.033                        | -0.013                               | -0.282| 0.239 | 0.462                |
| COC       | -0.096                        | 0.006                                | -0.198| 0.246 | 0.470                |
| COG       | 0.055                         | 0.006                                | -0.239| 0.239 | 0.720                |
| AWA       | -0.050                        | 0.007                                | -0.167| 0.172 | 0.580                |
Table 7. Sample characteristics

| Demographic details                                      | Students (n = 233) |
|----------------------------------------------------------|--------------------|
| Age                                                      | %                  |
| 18 years                                                 | 20.6               |
| 19 years                                                 | 26.6               |
| 20 years                                                 | 18.8               |
| 21 years                                                 | 16.8               |
| 22 years                                                 | 17.2               |
| Gender                                                   |                    |
| Male                                                     | 57.9               |
| Female                                                   | 42.1               |
| Family size (no of family members including respondent)  |                    |
| 1                                                       | 0                  |
| 2                                                       | 1.7                |
| 3                                                       | 14.6               |
| 4                                                       | 59.2               |
| More than 4                                              | 24.5               |
| Education                                                |                    |
| Arts                                                     | 8.2                |
| Commerce                                                 | 6.4                |
| Engineering                                              | 42.1               |
| Medical                                                  | 18.0               |
| Nursing                                                  | 14.2               |
| Sanskrit                                                 | 4.3                |
| Science                                                  | 6.8                |
| Geographical location                                    |                    |
| Rural                                                    | 46.4               |
| Urban                                                    | 53.6               |
| Income group                                             |                    |
| Below poverty (<50,000/year)                            | 3.4                |
| Lower class (50,000 to 450,000/year)                     | 26.2               |
| Lower middle class (450,000 to 600,000/year)             | 2.1                |
| Middle class (600,000 to 1,200,000/year)                 | 42.1               |
| Upper middle class (1,200,000 to 2,400,000/year)         | 15.9               |
| Rich class (> 2,400,000/year)                            | 10.3               |

Note: Income group is classified in INR

5.3. Stage 3: reliability and validity tests
Measurement model of SEM was initially developed to validate 84 items (excluding 06 demographics items) and results are presented in the following sections.

5.3.1. Model fit
Assessing whether the specified model “fits” the data is one of the primary steps before validating an instrument. The model fit for SEM-PLS is assessed by using standardised Root Mean Square Residual (SRMR), Normed Fit Index (NFI) and Root Mean Squared residual covariance matrix of outer model residuals (RMS_theta).

SRMR is the difference between observed correlation and the model implied correlation matrix, and it provides the average discrepancies between observed and expected correlations as an absolute measure of model fit (J. Hair et al., 2017). If the standard value of SRMR is less than 0.1, it can be considered as a good model fit and in the present case, the value of SRMR is found to be 0.079 and hence it demonstrates a good model fit.

NFI assesses the model correlation of measured variables with statistic range from 0 to 1. The closer the value to 1, better is the model fit (Smith & McMillan, 2001). In this case, NFI obtained is 0.932 which shows that there is a good model fit.
Another way of assessing model fit is using RMS_Theta. This value assesses the degree to which the outer model residuals correlate. A value closer to 0 indicates a good model fit and Henseler et al. (2014) suggests that RMS_theta value of less than 0.12 indicates a well-fitting model. In the present case, it is observed that the RMS_theta value is 0.114 which indicates the outer model residuals are very small and demonstrates a good model fit.

Based on the above results it can be concluded that the proposed SEM model for this research has a good model fit. Table 8 shows model fit results.

5.3.2. Internal consistency
The first evaluation that was carried out was internal consistency (reliability) which applies to how well a group of items measure the same characteristics of a concept in different contexts of test-retest procedures (Bannigan & Watson, 2009). Internal consistency is a widely used instrument testing method for its efficiency in identifying the errors due to sampling of instrument contents. Thus, the theory is “the higher the internal consistency, reliability of the instrument will be higher’ (McDowell & Newell, 1996, p. 40). The most commonly used criterion for internal consistency is Cronbach’s alpha. Nunally (1995) highlights that Cronbach alpha is the best estimate of reliability as the major errors of instrument is due to the sampling of its contents and it reflects the internal correlations of the observed variables. An alpha value of 0.7 is considered to be an acceptable threshold value for reliability. In the present case, Cronbach alpha values of all factors ranged from 0.7 to 0.9 except for SWMB2 which had 0.680. However, SWMB2 was retained considering the earlier studies which states that if the item is relevant and nearer to 0.7, it can be retained (Chan & Idris, 2017). Additionally, in SEM-PLS, the limitation of Cronbach’s alpha is that it is sensitive to the number of items and generally it provides a more conservative measure of internal consistency (J. Hair et al., 2017). Hence, an alternate approach is used in SEM-PLS which is referred as composite reliability, where the values of 0.6 to 0.9 are acceptable in exploratory research and 0.7 to 0.9 are acceptable in advanced research (Taber, 2018). Another measure of composite reliability usually considered in SEM analysis is Rho-A, the values of which are above 0.6 and can be considered acceptable (Rigdon et al., 2010). On the whole, Cronbach values ranging from 0.6 to 0.9 indicate a moderate to high level of acceptance, composite reliability values of 0.6 to 0.9 confirm satisfactory levels of acceptance and Rho-A value of above 0.6 indicates that the measures of internal consistency are satisfactory as shown in Table 9.

5.3.3. Convergent validity
Correlational evidences of an item association with other items of same latent variables are considered to be a vital factor while developing an effective questionnaire. This is because, indicators of a construct are expected to either converge or have a same proportion of variance. Hence, convergent validity, which is the degree to which the measurement model under progress correlates with measurement scale is regarded as one of the prerequisites in testing a hypothesis development. Convergent validity, an assessment of sensitivity of a measurement scale is assessed by outer loading factors and average variance extracted (AVE). The general understanding is that, greater the outer loading value, items of the measurement deals with the same concept of latent construct. Hair Jr et al. (2014) recommend to consider the outer loading values of greater than 0.7 for convergent validity and 0.5 for AVE. In the present case, each item was assessed for construct validity and items shown in Table 9 were retained and remaining indicators

| Table 8. Results of model fit for measurement model |
|-----------------------------------------------|
| Fit indices         | Saturated Model | Estimated Model |
|---------------------|-----------------|-----------------|
| SRMR                | 0.058           | 0.079           |
| NFI                 | 0.932           | 0.902           |
| RMS_Theta           |                 | 0.114           |
were eliminated due to low factor loadings. It is seen from Table 10 that all constructs have AVE values of greater than 0.5. Hence, based on AVE and factor loading values, we conclude that the convergent validity of the SWMB model is established.
5.3.4. Discriminant validity
The extent to which one latent variable is different from other latent variables of a construct is an important criterion in validating a questionnaire. This is because, if they are not mutually exclusive, the items of measurement may measure the same variable again and again, which is not productive.

Table 10. Factor loadings and reliability measures after factor reduction

| Construct | Items | Factor Loadings | AVE  |
|-----------|-------|-----------------|------|
| SWMF      | SWMF2 SWMF4 SWMF5 SWMF6 | 0.721 0.720 0.742 0.734 | 0.532 |
| WDB       | B1 B2 B3               | 0.792 0.846 0.747 | 0.633 |
| WUB       | B5 B7 B8 B9            | 0.765 0.832 0.728 0.796 | 0.610 |
| WCB       | B13 B14 B15            | 0.842 0.823 0.788 | 0.669 |
| GDB       | B22 B25 B26            | 0.779 0.819 0.806 | 0.643 |
| SWMA      | SWMA1 SWMA2 SWMA3 SWMA4 | 0.843 0.757 0.794 0.709 | 0.604 |
| ENK       | A1 A2 A3               | 0.819 0.892 0.843 | 0.726 |
| MOR       | A11 A12 A13 A15        | 0.710 0.725 0.702 0.794 | 0.538 |
| SWMI      | SWM2 SWM3 SWM5 SWM6   | 0.862 0.849 0.862 0.780 | 0.704 |
| SN        | I1 I4 I5               | 0.848 0.760 0.856 | 0.677 |
| PBC       | I7 I8 I10              | 0.862 0.796 0.801 | 0.673 |
| COC       | I13 I14 I16 I18       | 0.773 0.811 0.745 0.718 | 0.581 |
| COG       | I19 I20 I21           | 0.751 0.845 0.824 | 0.652 |
| AWA       | I26 I28 I29           | 0.832 0.804 0.843 | 0.683 |
| SWMB      | SWMB2 SWMB3 SWMB4     | 0.680 0.804 0.878 | 0.626 |
Schreiber et al. (2006) stressed that each factor is expected to measure a unique concept because their effect is associated with an observed variable collectively. Thus, establishing the uniqueness of each construct is a prerequisite in assessing the measurement scale and to meet this criterion, the usual method that is adopted is that the square roots of AVE of all the dimensions have to be greater than their respective correlation between the remaining constructs (J. Hair et al., 2017). In the present case as it is observed in Table 11, all factor loadings of indicators associated are greater than the cross loadings of the same indicators with other constructs and hence the discriminant validity of model is established.

5.3.5. SWMB measurement model after item reduction
Simplification of a model by selecting only parsimonious items that are best suited to a construct is an important aspect of an instrument development. As shown in Figure 3, it can be viewed that the model is simpler and less complex. It provides an overview of the assessment of factors by item reduction analysis. In total, 33 items were eliminated (SWMF—1, WDB—2, WUB—1, WCB—7, GDB—2; SWMA—1, ENK—5, MOR—1; SWMI—1, SN—3, PBC—2, COC—3, COG—1, AWA—2; SWMB—1) and these empirical results point towards a parsimonious model that depicts the relationships between various constructs and measures of SWBQ.

5.4. Stage 4: item elimination
The primary focus of this study was to design an instrument that can measure the antecedents of SWMB among youths. In that progression, 15 constructs were developed using TPB. This phase led to an initial pool of 132 items, which was later reduced to 116 items and 90 items, after considering wrong phrases, overlapping structures and mixed methods content analysis. Of 90 items, 84 items were again subjected to item reduction analysis. While identifying those items which are parsimonious, functional, and internally consistent, this study conducted internal consistency, composite reliability, convergent validity and discriminant validity tests by employing SEM-PLS technique. Finally, total number of items included were: 17 items for SWMF (WRB—3; WUB—4; WCB—3; GDB—3 and SWMF—4), 11 to SWMA (ENK—3, MOR—4 and SWMA—4), 20 to SWMI (SN—3, PBC—3, COC—4, COG—3, AWA—3 and SWMI—4) and 3 items for SWMB. After elimination of 33 items due to validation procedure, the final version of SWBQ was designed with 57 items that included 6 demographic items. Table 12 shows total number of items that were carried over for the final form of SWBQ development.

5.4.1. Stage 5: Final questionnaire development
A total of 57 indicators (including 6 demographic factors) were compiled and a questionnaire for primary data collection was thus developed, which formed the final version of SWBQ. The fifth and final version of developed SWBQ is provided in Appendix I.

6. Discussion
Our literature review revealed the need for a well-developed, reliable and valid method of measuring a questionnaire in the SWMB context. Such a structure of measurement is considered to be a necessity for theory building research, where the accuracy of measures depends on the integrity of a study while exploring a complex phenomenon such as SWMB. The procedures adopted were appropriate and rigorous, and it comprised systematic methods of item collection, content validity using mixed methods procedure, pre-testing questions, survey administration, establishing MI and pooling the data, item reduction analysis, scale evaluation using CFA, data merging using MICOM, tests of reliability and validity using SEM-PLS and finally developing a questionnaire that is ready to be used for primary data collection. In scale development phase, item reduction was undertaken to ensure that only parsimonious, operative and internally consistent items are included to ultimately elevate the efficiency of items that can best capture behavioural aspects of SWM of an individual. The obtained results of validity and reliability tests using non-parametric procedure of variance-based SEM indicates that the preliminary ground work pertaining to item generation and item collection is crucial and item reduction during the initial stages of scale development is a prerequisite in attaining the recommended values of parameters estimation.
|      | ENK  | MOR  | WDB  | WUB  | WCB  | GDB  | SN   | PBC  | COC  | COG  | AWA  | SWMA | SWMB | SWMF | SWMI |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| ENK  | 0.852| 0.734| 0.796| 0.582| 0.825| 0.818| 0.761| 0.781| 0.825| 0.781| 0.825| 0.781| 0.825| 0.781| 0.825|
| MOR  | 0.628| 0.734| 0.796| 0.421| 0.625| 0.612| 0.802| 0.781| 0.612| 0.802| 0.781| 0.612| 0.802| 0.781| 0.612|
| WDB  | 0.481| 0.388| 0.599| 0.388| 0.421| 0.448| 0.418| 0.421| 0.448| 0.418| 0.421| 0.448| 0.418| 0.421| 0.448|
| WUB  | 0.560| 0.494| 0.421| 0.399| 0.544| 0.517| 0.294| 0.399| 0.544| 0.517| 0.294| 0.399| 0.544| 0.517| 0.294|
| WCB  | 0.623| 0.574| 0.645| 0.599| 0.645| 0.599| 0.645| 0.599| 0.645| 0.599| 0.645| 0.599| 0.645| 0.599| 0.645|
| GDB  | 0.575| 0.645| 0.599| 0.544| 0.421| 0.448| 0.418| 0.421| 0.448| 0.418| 0.421| 0.448| 0.418| 0.421| 0.448|
| SN   | 0.582| 0.604| 0.294| 0.454| 0.468| 0.421| 0.582| 0.820| 0.468| 0.421| 0.582| 0.820| 0.468| 0.421| 0.582|
| PBC  | 0.484| 0.558| 0.399| 0.599| 0.645| 0.517| 0.294| 0.399| 0.544| 0.517| 0.294| 0.399| 0.544| 0.517| 0.294|
| COC  | 0.564| 0.631| 0.421| 0.410| 0.645| 0.517| 0.294| 0.399| 0.544| 0.517| 0.294| 0.399| 0.544| 0.517| 0.294|
| COG  | 0.564| 0.631| 0.421| 0.410| 0.645| 0.517| 0.294| 0.399| 0.544| 0.517| 0.294| 0.399| 0.544| 0.517| 0.294|
| AWA  | 0.598| 0.646| 0.599| 0.421| 0.625| 0.612| 0.802| 0.781| 0.612| 0.802| 0.781| 0.612| 0.802| 0.781| 0.612|
| SWMA | 0.698| 0.664| 0.410| 0.410| 0.645| 0.517| 0.294| 0.399| 0.544| 0.517| 0.294| 0.399| 0.544| 0.517| 0.294|
| SWMB | 0.684| 0.683| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603|
| SWMF | 0.684| 0.683| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603| 0.603|
| SWMI | 0.501| 0.567| 0.273| 0.273| 0.273| 0.273| 0.273| 0.273| 0.273| 0.273| 0.273| 0.273| 0.273| 0.273| 0.273|

**Table 11. Discriminant validity**

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Table 12. Summary of number of items carried over for primary data collection

| Construct    | No of items carried from phase 2 | Deleted | Total no of items carried over for primary data collection |
|--------------|----------------------------------|---------|-----------------------------------------------------------|
| Demographics | 6                                | 0       | 6                                                          |
| SWMF         | 5                                | 1       | 4                                                          |
| WDB          | 5                                | 2       | 3                                                          |
| WUB          | 5                                | 1       | 4                                                          |
| WCB          | 10                               | 7       | 3                                                          |
| GDB          | 5                                | 2       | 3                                                          |
| SWMA         | 5                                | 1       | 4                                                          |
| ENK          | 8                                | 5       | 3                                                          |
| MOR          | 5                                | 1       | 4                                                          |
| SWMI         | 5                                | 1       | 4                                                          |
| SN           | 6                                | 3       | 3                                                          |
| PBC          | 5                                | 2       | 3                                                          |
| COC          | 7                                | 3       | 4                                                          |
| COG          | 4                                | 1       | 3                                                          |
| AWA          | 5                                | 2       | 3                                                          |
| SWMB         | 4                                | 1       | 3                                                          |
| **Total**    | **90**                           | **33**  | **57**                                                     |

Figure 3. Measurement model of SWMB after item reduction.

Note: SWMF—Solid waste management belief; BEF1—Waste reduce belief; BEF2—Waste reuse belief; BEF3—Waste recycle belief; BEF4—General disposal belief; SWMA—Solid waste management attitude; ATT1—Environmental knowledge; ATT2—Moral obligation; SWMI—Solid waste management intention; INT1—Subjective norms; INT2—Perceived behavioural control; INT3—Community concern; INT4—Community groups; INT5—Awareness; SWMB—Solid waste management behaviour.
In quantitative environmental psychology, one of the most critical scrutiny while designing an instrument that is to be served for primary data collection is: whether a set of items assess one concept in common. In other words, the retained items in scale measurement must all be the indicators of common underlying construct and its respective items should share common variance (Falissard, 1999; Gardner, 1995; Gerbing & Anderson, 1988; Pingault et al., 2012). In order to achieve this criterion, this study employed CFA to test whether the item scores are measuring the same concept that is supposed to be measured. The obtained validity and reliability test scores illustrate that our findings have substantial loadings providing the strongest evidence to support the claim that our developed scale is unidimensional. Cronbach alpha statistics which is most widely used estimating factor for internal consistency is satisfactory indicating that every item in our scale shares common variance with at least some other item in the scale. In addition, our Rho-A values and composite reliability values are excellent which illustrates the cohesiveness of the scale. Further, the sophisticated reliability values are excellent which illustrates the cohesiveness of the scale. Further, the sophisticated reliability values are excellent which illustrates the cohesiveness of the scale. Further, the sophisticated reliability values are excellent which illustrates the cohesiveness of the scale.

Further, the goal of this study was not only to identify irrelevant or least related items of the domain of interest, but the research basically looked for statistical tests to understand whether the collected data fits SWMB measurement model and provide a robust validation output for the developed questionnaire. Researchers from several fields suggest that the validation of a scale is well depicted with improved results when CFA and SEM are applied together (Bryant & Yarnold, 1995; Kyriazos, 2018; Sarstedt & Cheah, 2019; Schreiber et al., 2006). CFA assesses all psychometric properties through statistical tests and SEM provides straight-forward multiple relationship results through statistical efficiency. Drawing the advantages of using them together, scientists have utilized this prominent approach to estimate the models in the fields of business research, knowledge management, agriculture, pharmacy and psychology (Abbasi & Zamani-Miandashti, 2013; Hadrich & Olson, 2011; Huang & Lai, 2012; Prabhu et al., 2011; Rabaa’i, 2016; Wang & Ahmed, 2004). It was hence the scope of this paper to utilize the applications of CFA and SEM in the domain of environmental management as well to estimate the values of indicators, assess the parameters of SWMB constructs and to technically reduce the difference between estimated and observed matrices. We hope that this adoption of CFA and SEM combination brings a transition of developing more systematic method of questionnaire validation in environmental management field too, which is regarded as a holistic way of developing a questionnaire. An overview of systematic and methodical stages of item reduction and scale development that we adopted in this study is depicted in Figure 4.

7. Conclusion
Studies pertaining to scale measurement within SWMB domain are scarce and hence we attempted this research to contribute to the content of international literature. Although this study is unique in many ways, this study is novel in two ways. First, this research on development and validation of SWMB instrument utilized mixed methods approach of content validity, which is kind of first in environmental psychology. This approach is apt since TPB is basically a theory-driven framework and estimation of content validity using primary concepts of the theory (qualitative) and then empirically (quantitative) testing the items measure the core concepts of the theory. Since the theoretical frameworks are qualitative and the evaluation of item alignment to the core concepts are quantitative (Newman et al., 2013), we have attempted to design the questionnaire using mixed methods procedure of content validity. This approach aided in item purification process as it underwnt the strengths of both techniques. Second, this research employed MICOM procedure of SEM-PLS version 3.0 to merge the samples collected from rural and urban groups of pen/pencil and web-based survey administration. MICOM, the new method of merging data was useful in establishing MI among different groups and cultures and this new feature was found to be less complex as compared to other techniques. We hope this study would benefit other researchers to conduct more such research in environmental management discipline and
utilize this method of content validity and data pooling techniques which have the potency to enhance the quality of items as explained in this article.

This scale is basically designed to capture the behavioural antecedents of SWMB among youths. However, the systematic and extensive methods utilized in this research hold appropriate to all sampling units. Hence the procedures presented in this paper can be extended to other target population such as retirees, housewives, general population, school children, etc. The MICOM procedure to merge two types of survey data and the measurement scale techniques which underwent strict and robust tests provided replicable and trustworthy results showing that the final indicators adopted in this study are suitable for repeatability in different settings and contexts as well. Thus the scope of this paper is accomplished by contributing to the content of international and progressive research, and its higher purpose of environmental protection. Further, to strengthen the rigour of the instrument, for future research we recommend undertaking mixed
methods content validity using covariance-based methods (SEM-Analysis moment of structure) to compare the efficiency of statistical techniques.

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Appendix I

### SOLID WASTE MANAGEMENT BEHAVIOUR

#### Confidentiality Statement

The data collected through this questionnaire shall be used purely for academic research purpose. No mention of the respondent or the organization to which he/she belongs shall be used anywhere.

#### Section 1: Demographic Details

| Age          | 18 years | 19 years | 20 years | 21 years | 22 years |
|--------------|----------|----------|----------|----------|----------|
| Gender       | Male     | Female   |          |          |          |
| Family Size (Members): | 1 | 2 | 3 | 4 | >4 |
| Education    | Diploma  | Arts     | Commerce | Engineering | Science |
|              | Medical  | Sanskrit | Others   |            |          |
| Place of living: | Rural | Urban |          |            |          |
| Income group: | Below Poverty Line (<50K per year) | Lower Class (50K to 4.5 Lacs per year) | Lower Mid Class (4.5 Lacs to 6 Lacs per year) | Middle class (6 Lacs to 12 Lacs) | Upper Middle class (12 Lacs to 24 Lacs) | Rich Class (>24 Lacs) |

Note: Income group is classified in INR

Place Tick mark (✓) on ONE response for each item

1-Strongly Agree 5–Strongly Disagree 1 2 3 4 5

#### Section 2: Solid Waste Management Belief (SWMF)

1. There is nothing more important in life than segregating wastes to protect environment.

2. I find it makes sense for me to do everything to protect environment even though other people do not do the same.

3. Environmental problems have direct effects on everyday life.

4. Waste separation activities will improve environmental quality.

#### 1. Waste Reduction Belief

1. Use of materials that could potentially be trash should be reduced.

2. Products which can be used again and again should be promoted.

3. I look for products with reusable packaging.

#### 2. Waste Reuse Belief

1. I like reusing of items to avoid garbage.

2. Reusing of item saves money.

3. It is my custom to reuse items to save energy.
4. Waste reduction creates better environment for future generations.

3. Waste Recycle Belief
1. Recycling will reduce pollution.
2. Recycling is important to save energy.
3. Recycling takes too much time.

4. Waste Disposal Belief
1. Disposal of wastes should be carried out in respective bins.
2. Waste disposal should be a daily household activity to maintain good health.
3. Checking whether the item can be recycled/reused before disposal is the right way to tackle environmental issues.

| Section 3: Solid Waste Management Attitude (SWMA) |
|--------------------------------------------------|
| 1. I feel good about myself when I recycle.       |
| 2. I have the responsibility to reduce the amount of waste generated. |
| 3. I feel angry if others discard wastes in public places. |
| 4. I think waste separation at home is a good activity. |

1. Environmental Knowledge
1. I know that separation of household wastes reduce landfill space.
2. I know that during the years to come, thousands of species will become non-extinct due to improper waste management.
3. I know that kitchen wastes can be used as compost.

2. Moral Obligation
1. I separate waste out of my sense of responsibility to protect the environment.
2. I feel that waste separation is a virtue.
3. I feel guilty if I did not separate waste properly.
4. I feel I should not waste anything if it could be used again.

| Section 4: Solid Waste Management Intention (SWMI) |
|--------------------------------------------------|
| 1. I intend to separate wastes at home regularly. |
| 2. I will make an effort to involve in recycling activities. |
| 3. I intend to participate in SWM programs organised by local authorities. |
| 4. I will engage in Government’s solid waste management plans in near future. |

1. Subjective Norms
1. My family thinks that I should indulge in waste management behavioural activities.
3. The community in the area I live thinks that I should involve in waste management behavioural activities.
4. My relatives think that my waste management behavioural activities would save environment from further complications.

2. Perceived Behavioral Control
1. I think I have the skill of handling wastes effectively.

2. I have plenty of opportunities to recycle my household waste.

3. I have complete control in deciding whether or not to recycle wastes at home.

### 3. Community Concern

1. I want my locality to be a healthy place to live.

2. I have a strong affinity to the locality I live in.

3. I accept waste management activities since it creates job opportunities in my locality.

4. I want to adhere to Government policies which can help to keep my locality clean.

### 4. Community Groups

1. Community based initiatives can enhance waste management behaviour among youths.

2. Building partnerships with NGOs and private sector can improve waste management behaviour among citizens.

3. Community group involvement is vital for environmental quality of country.

### 5. Awareness

1. I am aware that recycling methods can bring economic benefits to the country.

2. I am aware of methods to separate wastes.

3. I am aware of government’s waste management programs.

### Section 5: Solid Waste Management Behaviour (SWMB)

1. I have never recycled household wastes.

2. I recycle cans, newspaper, bottles etc. at home.

3. I have high involvement in waste reduce activities.
