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Validation of smartphone addiction scale-short version among Malaysian undergraduate students

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ABSTRACT

Smartphone addiction scale-short version or SAS-SV has been consistently found to have one-factor structure and proven as a valid and reliable instrument to measure smartphone addiction. However, it has not been validated among the undergraduate students in Malaysia. With the aim to address such empirical gap, this study has validated its one-factor structure and assessed its reliability and validity among the 680 undergraduate students in Universiti Teknologi Malaysia (UTM). Its content validity was first demonstrated. Subsequently, the findings of confirmatory factor analysis (CFA) have supported and confirmed its one-factor model. Furthermore, its convergent validity and reliability were also proven to be satisfactory. Taken together, this study has demonstrated that SAS-SV is an instrument that can reliably and accurately measure or identify smartphone addiction symptoms among the undergraduate students in Malaysia.

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1. INTRODUCTION

Smartphone has been widely perceived as a life necessity in today's environment through which people can access to internet, entertainment, retrieve information, and stay connected with families/friends. Despite the innumerable benefits smartphone brought to human life (e.g., personal, work), due to its highly portable and multifunctional nature, many people nowadays tend to spend excessive time on the use of smartphone or certain smartphone features (e.g., social media/games), which has been argued to interfere the obligations/tasks in work/social life and subsequently cause detrimental life outcomes [1]. Despite their awareness of the aversive consequences associated with excessive smartphone use and recognition that there is a need to regulate their smartphone usage, many people have failed to regulate their smartphone usage or have lost control over their smartphone usage [2], [3]. In the existing literature, people with such symptoms were deemed to have smartphone addiction, which refers to the inability to limit smartphone usage despite the recognized negative consequences [4].

Previous studies have repeatedly highlighted that smartphone addiction can cause several detrimental outcomes such as mental health issues [5], poor physical fitness [6], sleep interferences [7], and poor academic performance [8]. Inspired by these, scholars have argued that screening instrument that can differentiate people with smartphone addiction from those without smartphone addiction is needed so that a more targeted intervention can be taken by relevant parties (e.g., government, psychologists) [3], [9]. Accordingly, a variety of instruments were developed by researchers to identify smartphone addiction symptoms (refer to [10] for a thorough review of the existing screening tools for smartphone addiction).

Among the existing instruments, smartphone addiction scale-short version (SAS-SV) has been identified as one of the most adopted instruments to screen for smartphone addiction symptoms [10], [11]. This instrument was composed by 10 items that reflect the extent to which one is unable to regulate his/her smartphone usage when he/she has already recognized its associated detrimental outcomes and the need to regulate his/her smartphone usage [12]. Previous studies have consistently found that SAS-SV has one-factor structure and demonstrated its satisfactory validity and reliability among various sample types across countries, which include samples from countries located in Asia such as adolescents in Korea [12] and general adults in Hong Kong [13], Europe such as university students in Italy [14], general adults in Spain and Belgium [15], medical students in Serbia [16] and adolescents and young adults in Italy [17], Africa such as general adults in Morocco [18], South America such as general adolescents in Brazil [19], and lastly North America such as university students in Mexicans [20].

Despite the fact that numerous studies have consistently found one-factor structure of SAS-SV and demonstrated its satisfactory validity and reliability among various sample types across countries, it has not been validated among the undergraduate students in Malaysia. In this regard, due to cultural/cognitive differences, scholars have argued that different people (e.g., general adults, emerging adults, adolescents, and children) in different countries may perceive or/and interpret its items differently. Accordingly, its psychometric properties (e.g., factor structure, validity, reliability) can potentially be different among different sample types across countries [3]. Inspired by these notions, this study aims to investigate i) whether the one-factor structure of SAS-SV can be supported and ii) whether SAS-SV can reliably and accurately identify smartphone addiction symptoms among undergraduate students in Malaysia.

2. RESEARCH METHOD

2.1. Sampling and data collection

Respondents in the present study were the undergraduate students in Universiti Teknologi Malaysia (UTM). In the present study, stratified random sampling was applied to draw undergraduate student samples from UTM. Specifically, based on the ratio of the numbers of undergraduate students in each faculty to the total number of undergraduate students in UTM, a set of undergraduate student samples were randomly drawn from the nine faculties in Universiti Teknologi Malaysia. Through matching the number of undergraduate students in each of the nine faculties, such sampling approach can produce a set of representative undergraduate student samples and generate findings that are generalizable to the undergraduate students in UTM.

Regarding the data collection procedures, a list of class schedules was first retrieved from the undergraduate office of each faculty, and from which, the classes to target for data collection were randomly selected. Subsequent to these, the student list of each targeted class was retrieved from its corresponding undergraduate office and 20 undergraduate students were randomly selected from each targeted class to participate in the present study. Based on the procedures noted above, 680 self-reported physical questionnaires were collected from the undergraduate students in University Teknologi Malaysia and used for validation.

With the aim to demonstrate that the findings generated in this study have adequate statistical power and they are generalizable to all undergraduate students of UTM, several sample size thresholds were referred. Firstly, Saunders *et al.* [21] have argued that 300 samples are generally sufficient to represent a large population. Secondly, based on the rule of thumb by Krejcie and Morgan [22], 375 samples are enough to represent the 14,706 undergraduate students in UTM. Thirdly, according to Hair, Black, Babin and Anderson [23], 400 samples are generally enough for social/behavioral research to produce research findings with good statistical power. Lastly, according to Kline [24], 20 samples per measurement item are required to generate findings with good statistical power. Accordingly, given the fact that there are 10 items in SAS-SV [12], 200 samples are needed for the present study to generate findings with good statistical power. Based on the sample size thresholds highlighted above, 680 undergraduate student samples were enough for the current study to generate findings generalizable to the undergraduate students of UTM and findings with good statistical power.

2.2. Research instrument

Firstly, the basic demographic information of respondents was recorded that include age, gender. In this regard, gender is particularly relevant due to the fact that the cut-off value in SAS-SV to determine whether male or female is addicted to smartphone use is different (refer to following paragraphs for more details).

Secondly, in the current study, smartphone addiction was measured through SAS-SV. Smartphone addiction scale (SAS) was originally developed as a 33-item scale [12]. Although numerous studies have

already demonstrated that it can reliably and accurately identify smartphone addiction symptoms [12], [19], [25], scholars have argued that its lengthy form can potentially occupy too much time of the targeted respondents and thus negatively influence response/participation rate [12]. Inspired by these, with the aim to reduce the burden on respondents, Kwon *et al.* [12] have shortened the length of 33-item SAS. More specifically, a panel of 7 psychologists have identified 10 items with highest relevance and subsequently employed by Kwon *et al.* [12] to construct a shorter version of smartphone addiction scale (i.e., SAS-SV) (refer to Table 1 for the measurement items).

In the SAS-SV, smartphone addiction symptoms were assessed based on a 6-point scale (1-strongly disagree to 6-strongly agree). Accordingly, the minimum score is 10 whereas the maximum is 60 and these can be used to identify the level of smartphone addiction symptoms. Furthermore, Kwon *et al.* [12] have also proposed cut-off values to determine whether a person is addicted to smartphone use. Specifically, when male has a score of 31 (or higher) or female has a score of 33 (or higher), they can be determined to have smartphone addiction.

Table 1. The items of Smartphone addiction scale-short version (SAS-SV)

No	Measurement items
SAS-SV1	I have missed planned work due to smartphone use.
SAS-SV2	I have had a hard time concentrating in class or while doing assignments due to smartphone use.
SAS-SV3	I have felt pain in the wrists or at the back of the neck while using smartphone.
SAS-SV4	I could not stand not having my smartphone.
SAS-SV5	I have felt impatient and fretful when I am not holding my smartphone.
SAS-SV6	I have had my smartphone in my mind even when I am not using it.
SAS-SV7	I could not give up using my smartphone even when my daily life was already greatly affected by it.
SAS-SV8	I was constantly checking my smartphone so as not to miss conversation between other people on social media sites (e.g., Facebook, Instagram, WhatsApp, WeChat).
SAS-SV9	I have used my smartphone for longer than I intended to.
SAS-SV10	People around me told me that I use my smartphone too much.

2.3. Data analysis

2.3.1. Content validity

In this study, in order to demonstrate that the measurement items in SAS-SV can measure what they were supposed to measure (i.e., smartphone addiction symptoms), content validation index (CVI) was employed to examine its content validity [26]. Specifically, two experts specialized in psychology were invited to rate how relevant the measurement items were in identifying smartphone addiction symptoms based on 4-point scale (1-not relevant to 4-highly relevant). In this regard, based on the guidelines provided by Yusoff [26], an item was judged as a valid item when it was given a rating of "3" or "4" whereas an item was judged as invalid item when it was given a rating of "1" or "2". Subsequently, based on the proportion of valid items in the 10 measurement items, CVI was computed. For instances, if all the 10 items were identified as valid items, the corresponding content validation index (CVI) would be 1 (10/10). Based on this logic, if 8 items were identified as valid items, the corresponding CVI would be 0.8 (8/10). As noted previously, two experts specialized in psychology were invited to assess content validity and therefore there were two different sets of CVI. In order to generate overall content validation index, the two-content validation index were averaged. In this regard, Yusoff [26] has highlighted that, in order to demonstrate adequate content validity, a measurement scale should have a score of at least 0.8 in overall CVI. When a measurement scale has a score lower than 0.8 in overall CVI, changes to or removal of the invalid items should be considered. In addition, the two experts involved in the present study were also requested to identify grammatical errors and ambiguous items and provide suggestions for revision.

2.3.2. Pilot test

Prior to large-scaled questionnaire distribution, a set of five convenience samples of undergraduate student in Universiti Teknologi Malaysia were recruited to check whether the terms used in the questions and the meaning of all the questions provided were clear and understandable. Subsequently, with the aim to ensure that the SAS-SV developed by Kwon *et al.* [12] can function as intended among the undergraduate students in Malaysia, a pilot test or a small-scaled trial run was conducted with 100 undergraduate students in Universiti Teknologi Malaysia (UTM) before the full-fledged validation. In this regard, factor structure, convergent validity, and reliability were assessed (refer to section 2.3.3, 2.3.4 and 2.3.5 for details on the specific indicators examined and minimum threshold for each one of them).

2.3.3. Factor structure

As noted in section 1, the short version of smartphone addiction scale developed by Kwon *et al.* [12] has been consistently found to have one-factor structure among various sample types across countries [12]–[15], [19]. Accordingly, since there has been clear prior knowledge on its factor structure, this study aims to confirm or validate its one-factor structure among the undergraduate students in Malaysia rather than to explore/specify the construct dimensions. In such case, confirmatory factor analysis (CFA) was deemed more suitable for the current study than exploratory factor analysis (EFA) [27]. The model fit of a measurement model with the 10 items specified to a single/one-factor was first examined. In this regard, Hair *et al.* [23] have highlighted that when parsinoomy normed fit index (PNFI) is 0.50 (or higher), root mean square error of approximation (RMSEA) is 0.08 (or lower), comparative-fit-index (CFI) is 0.90 (or higher), normed chi-square ($\chi 2$/df) is 3 (or lower), and tucker-lewis index (TLI) is 0.90 (or higher), measurement model can be considered to have a good model fit.

2.3.4. Convergent validity

In the current study, convergent validity was assessed based on the guidelines proposed by Hair *et al.* [23]. Specifically, when measurement scale has i) all items with 0.60 or higher factor loadings, and ii) 0.50 or higher on average variance extracted (AVE), it can be considered to have good convergent validity.

2.3.5. Reliability

In this study, reliability was assessed based on the guidelines proposed by Hair *et al.* [23]. Specifically, when measurement scale has 0.70 or higher on both composite reliability and Cronbach's alpha, it can be considered to have good internal consistency or reliability.

3. RESULTS AND DISCUSSION

3.1. Content validity

Overall CVI need to be 0.80 (or higher) in order to establish content validity for the short version of smartphone addiction scale developed by Kwon *et al.* [12]. In this regard, as shown in Table 2, its 10 items were all rated by two experts as valid items to reflect the construct of smartphone addiction. Accordingly, the overall content validation index was 1 and thus its content validity was deemed adequate or satisfactory. Furthermore, experts have also identified some ambiguity and grammatical mistakes in the measurement items and provided suggestions for revisions. Based on the advices of experts, the ambiguous items and items with grammatical errors were subsequently amended. All symbols that have been used in the equations should be defined in the following text.

Table 2. Content validation index

Measurement scale	Total number of items	Expert 1			Expert 2			Overall CVI
		Valid items	Invalid items	CVI	Valid items	Invalid items	CVI	
SAS-SV	10	10	0	1	10	0	1	1

3.2. Pilot test

As noted in section 2.3.2, five undergraduate students in Universiti Teknologi Malaysia (UTM) were recruited to check whether the terms used in the questions and the meaning of all the questions provided were clear and understandable. In this regard, after checking the 10 measurement items, they have reported that all the terms used and the meaning of the questions were clear and understandable and they did not face any difficulty in answering the questions.

Subsequently, a pilot test or a small-scaled trial run was conducted with one hundred undergraduate students in Universiti Teknologi Malaysia (UTM). In this regard, as noted in 2.3.2, the factor structure, convergent validity, and reliability were assessed. With regard to factor structure, as shown in Table 3, the one-factor model structure was found to have 0.712 on parsimony normed fit index (PNFI), 0.915 on TLI, 1.360 on normed Chi-square ($\chi 2$/df), 0.06 on root mean square error of approximation (RMSEA), and 0.920 on comparative-fit-index (CFI). These have reflected a good model fit of the one-factor model structure.

Table 3. Measurement model fit in pilot test

Goodness-of-fit indices	Threshold value for good fit	Actual value
RMSEA	0.08 or lower	0.06
CFI	0.90 or higher	0.920
TLI	0.90 or higher	0.915
PNFI	0.50 or higher	0.712
χ^2/df	3 or lower	1.360

Regarding convergent validity, apart from the item SAS-SV3, others have factor loading higher than 0.60. Furthermore, the AVE was also found to be higher than 0.50. These have reflected adequate convergent validity (refer to Table 4 for more details). Regarding the item SAS-SV3, in the stage of pilot test, its low factor loading can potentially be explained by the low sample size (i.e., 100). With a larger sample size, its factor loading may be improved to a satisfactory level. Accordingly, despite the fact that its factor loading was found to be lower than 0.60 in the stage of pilot test, SAS-SV3 was kept for the full-fledged validation in order to avoid discarding a measurement item that can potentially capture a relevant aspect of smartphone addiction.

Lastly, regarding reliability, the Cronbach's alpha and composite reliability were both found to be higher than 0.70 (refer to Table 4 for more details). These have reflected adequate reliability or internal consistency. Taken together, pilot test has demonstrated good reliability and validity and thus can be further validated.

Table 4. Convergent validity and reliability in pilot test

Measurement scale	Items	Factor loading	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
Smartphone addiction scale-short version (SAS-SV)	SAS-SV1	0.849	0.939	0.941	0.617
	SAS-SV2	0.840			
	SAS-SV3	0.515			
	SAS-SV4	0.806			
	SAS-SV5	0.821			
	SAS-SV6	0.803			
	SAS-SV7	0.759			
	SAS-SV8	0.832			
	SAS-SV 9	0.830			
	SAS-SV 10	0.743			

3.3. Factor structure

Subsequent to pilot test, full-fledged validation was conducted with 680 undergraduate students in Universiti Teknologi Malaysia. Regarding factor structure, as shown in Table 5, the one-factor model structure was found to have 1.912 on normed chi-square (χ2/df), 0.965 on TLI, 0.879 on parsimony normed fit index (PNFI), 0.037 on root mean square error of approximation (RMSEA), and 0.967 on comparative-fit-index (CFI). These have demonstrated a good model fit of one-factor model structure.

Table 5. Measurement model fit in full-fledged validation

Goodness-of-fit indices	Threshold value for good fit	Actual value
RMSEA	0.08 or lower	0.037
CFI	0.90 or higher	0.967
TLI	0.90 or higher	0.965
PNFI	0.50 or higher	0.879
χ^2/df	3 or lower	1.912

3.4. Convergent validity

It was found that the 10 measurement items have factor loading higher than 0.60 and the overall scale has an average variance extracted (AVE) higher than 0.50 (refer to Table 6 for more details). These have reflected adequate convergent validity.

3.5. Reliability

Cronbach's alpha and composite reliability were both found to be higher than 0.70 (refer to Table 6 for more details). These have reflected adequate reliability or internal consistency.

Table 6. Convergent validity and reliability in full-fledged validation

Measurement scale	Items	Factor loading	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
Smartphone addiction scale-short version (SAS-SV)	SAS-SV1	0.755	0.939	0.941	0.617
	SAS-SV2	0.817			
	SAS-SV3	0.617			
	SAS-SV4	0.794			
	SAS-SV5	0.802			
	SAS-SV6	0.783			
	SAS-SV7	0.782			
	SAS-SV8	0.792			
	SAS-SV 9	0.786			
	SAS-SV 10	0.694			

3.6. Discussions

This study mainly focuses on validating the SAS-SV developed by Kwon *et al.* [12]. More specifically, this study has validated its one-factor structure and assessed its reliability and validity. Initially, prior to the large-scaled data collection, the content of its 10 items was first evaluated by two experts specialized in psychology on how relevant they were in identifying smartphone addiction symptoms.

In this regard, as discussed in section 3.1, its 10 items were all verified as valid and highly relevant items to measure the construct of smartphone addiction (i.e., good content validity). Such finding was not surprising because its content validity has been repeatedly demonstrated by previous studies [12], [28], [29]. For examples, based on an evaluation by a panel of three psychiatrists, two nurses and two psychologists, its 10 items were all verified as valid and highly relevant items to measure the construct of smartphone addiction [12]. Similarly, based on an evaluation by a panel of two experts specialized in educational psychology and two experts specialized in psychometrics, its 10 items were all verified as valid and highly relevant items to measure the construct of smartphone addiction [29]. The assessment of content validity in the present study and previous empirical evidences noted above have all supported the relevance of its 10 items for the identification of smartphone addiction symptoms.

Regarding its factor structure, as noted in section 3.3, the one-factor model structure was found to have good model fit among the undergraduate students in Malaysia. Such finding has supported and confirmed the one-factor model structure identified by previous studies among various sample types across countries such as adolescents in Korea [12], university students in Italy [14], general adults in Hong Kong [13], general adolescents in Brazil [19], general adults in Spain and Belgium [15], general adults in Morroco [18], adolescents and young adults in Italy [17], university students in Mexicans [20], and medical students in Serbia [16].

With regard to convergent validity, as shown in section 3.4, the (SAS-SV) developed by Kwon *et al.* [12] was proven to have satisfactory convergent validity among the undergraduate students in Malaysia. Specifically, its 10 items were all loaded well on the one-factor model and found to share a high proportion of variance. Such finding was consistent with previous studies conducted among college students in United States [30], college students in China [31], and adolescents in Turkey [32]. Lastly, as shown in section 3.5, it has also demontrated good reliability among the undergraduate students in Malaysia. Such finding was similar to previous studies conducted among undergraduate students in China [29], university students in Italy [14], general adults in Morroco [18], general adolescents in Brazil [19], general adults in Hong Kong [13], and general adults in Spain and Belgium [15]. Taken together, one-factor model was supported or comfirmed and its validity and reliability were found to be satisfactory among the undergraduate students in Malaysia.

4. CONCLUSION

The one-factor model structure of the SAS-SV was supported in this study. Also, the findings of this study have demonstrated that it can reliably and accurately identify smartphone addiction symptoms among the undergraduate students in Malaysia. It may help in identifying the undergraduate student with smartphone addiction and enable relevant parties (e.g., ministry of education, university, counsellor) to initiate a more targeted intervention. Apart from content validity and convergent validity, it is recommended for future research to assess concurrent validity and predictive validity by examining its association with some external criterion variables. With these, a more thorough validation can be conducted. Secondly, this study has collected only data from the undergraduate students in Universiti Teknologi Malaysia (UTM). Accordingly, the findings of this study may not be generalizable to the undergraduates from other universities and students

in other level of study such as postgraduate/primary/secondary students. Accordingly, future validation study can contribute to the literature by validating the findings of the presenet study with other sample types (e.g., postgraduate, primary, secondary students).

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