Adaptation and validation of the smartphone addiction: a Rasch perspective

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Adaptation and validation of the smartphone addiction: a Rasch perspective

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Abstract Smartphone addiction has become a hot and alarming issue. Because the use of smartphones that are not controlled can impact the effectiveness of everyday life. For that required a valid instrument that can measure well the level of addiction to the smartphone. This research develops and validate the instrument of Smartphone Addiction Inventory. The sample used 84 students in Indonesia. Validation constructs, person and reliability using RASCH Model analysis. Based on the results of validity and reliability test shows that Smartphone Addiction Inventory meets the requirements of validity and reliability. Thus it can be identified that this instrument can measure the level of addiction to the Smartphone.

1. Introduction

In the era of globalization, smartphones have been regarded as a staple for society and become an integral part of everydaylife [1]–[4]. All information can be accessed via smartphone. Using smartphones is revolutionizing the way information is gained [5], [6]. Everyone can exchange information through various applications available in smartphones. The smartphone has many attractive attributes and characteristics that could make it addictive [1][7].

Smartphone addiction occurs because of its problematic and uncontrolled use [8]–[11]. Addiction designates a process whereby a behavior, that can function both to produce pleasure and to provide an escape from internal discomfort, is used in a pattern characterized by (1) recurrent failure to control the behaviour (powerlessness) and (2) continuation of the behaviour despite significant negative consequences (unmanageability) [12]. Addictions cause addictive symptoms in the form of bodily and / or psychical reactions that interfere with either or unintentionally, if the addictive object is not used [13]. This means that when someone is addicted to smartphones will be difficult to escape and become dependent with the smartphone.

Addiction to the smartphone has many negative impacts, both physical and psychological impact. Addiction to smartphone can affect physical and psychosocial health and overall quality of life [14], [15]. The physical impact of excessive smartphone usage cannot only cause mobility problems in the wrists, fingers and neck but also disorders of sleeping habits [16] and cognitive function [17]–[19]. While the psychic impact, Smartphone Addiction has a stronger relationship with depression [20], [21] and anxiety [13], [22], [23], stronger than Internet Addiction, and emphasized the need for prevention and management policy of the excessive smartphone use [8], [20], [24]. Other studies have shown students with high smartphone addictionshowed significantly more severe levels of behavioral and emotional problems, lower self-esteem , and poorer quality of communication with their parents [7]. Some things that are associated with the criteria of smartphone addiction among others [8], [25]) loss of control [12] against smartphone usage; 2) there is an ongoing trend towards smartphones; and 3) there is a change in the mood when feeling out of the smartphone in this case becomes depressed and anxious and high stress [16], [26]–[28].

The rate of addiction to a smartphone can vary from one individual to another [25], a valid and reliable instrument is required so it can measure the level of smartphone addiction. Smartphone Addiction Inventory is an instrument that can measure well the level of addiction to Smartphone.

2. Methods

2.1. Participant

The participant involved in this study as 84 students in Indonesia. Sample used simple random sampling. Smartphone Addiction Inventory is used to measure the level of smartphone addiction in students. The Smartphone Addiction Inventory contains 31 items used 5-point Likert rating scale [29]. The full analyzed item can be accessed in osf.io/v2eqm Open Science Framework [30].

2.2. Prosedure and Analisys

The data analysis of Smartphone Addiction Inventory refers to a good way to reporting results from a Rasch model, which is focused on estimating reliability components, validity, validity rating scale, separation index, item fit and item difficulty and test information function [31][32]. The software WINSTEPS 4.01 was used to generate and examine Smartphone Addiction Inventory.

Rasch modeling is the development of *Item Response Theory* (IRT) which has grown since the 1960s, in the field of *Social and Behavioral Sciences* [31][32]. The Rasch Model is considered an analytical method that has many advantages for providing objective measures, including: (1) providing a linear measure, (2) overcoming missing data, (3) having precise estimates, (3) finding misfits and outliers in the data, and (5) provides a measurement instrument independent of the parameters studied. The advantages mentioned are not obtained from the *Classical Test Theory* (CTT), which has been used by scientists *Social and Behavioral Sciences*, where the CTT is still influenced by the type of subject, assessment characteristics, sample size, the effect of limit and ceiling *(floor-ceiling effect)*, as well as the characteristics of measuring instruments [7][14][30]. The research data set can be accessed in osf.io/v2eqm Open Science Framework [30].

3. Result and Discussion

3.1 Reliability

There are three types of reliability tests performed on Smartphone Addiction, (1) reliability of items, (2) person reliability, and (3) reliability of interaction between items and person. Based on the reliability test known item reliability is .96 (SE of item mean = .13), for person reliability is .89 (SE of person mean = .08), and the interaction between items with the persons (Cronbach α) as a whole is .91. This shows that the consistency of answers from the respondents is excellent, and the quality of the items in Smartphone Addiction Inventory. The interaction between the person and the item is good.

3.2 Validity

To test whether the developed instrument can measure what should be measured (Validity) in this case the Smartphone Addiction Inventory constructs, then Principal Component Analysis (PCA) is used. Using PCA is based on residual values to estimate the diversity of the instruments against the measured component. In PCA, two main parameters are used: (1) raw value of observation value with the minimum value of 40%, and (2) total raw unexplained variance with the minimum value of 15%.

Table.1 Shows the PCA test results found that the diversity of measurement results can be explained that is equal to 41.4% and $\geq$ 40%. This is also followed by a diversity of unexplained measurement results based on unexplained variance in 1st - 5th ie less than 15%. Thus this condition shows that the unidimensionality requirements of the instrument are met, or all items used in the Smartphone Addiction Inventory instrument are valid.

Table 1. Standardized Residual Variancevariance (in Eigenvalue units)

		-- Empirical--			Modeled
Total raw variance in observations	=	52.9	100.0%		100.0%
Raw variance explained by measures	=	21.9	41.4%		40.8%
Raw variance explained by persons	=	5.8	10.9%		10.8%
Raw Variance explained by items	=	16.1	30.4%		30.0%
Raw unexplained variance (total)	=	31.0	58.6%	100.0%	59.2%
Unexplned variance in 1st contrast	=	3.6	6.8%	11.6%	
Unexplned variance in 2nd contrast	=	2.5	4.8%	8.1%	
Unexplned variance in 3rd contrast	=	2.4	4.6%	7.8%	
Unexplned variance in 4th contrast	=	2.3	4.3%	7.3%	
Unexplned variance in 5th contrast	=	2.0	3.8%	6.4%	

Standardized Residual Variance Scree Plot

3.3 Validity of Rating Scale

The verification process for an assumption test on rating used in Smartphone Addiction Inventory uses "R" modeling, that is by seeing the increase of a monotonic measurement score on observed average parameter and coherence value of answer choice provided.

Table 2. Summary of Category Structure Model="R"

CATEGORY	**OBSERVED**		**OBSVD**	**SAMPLE**	**INFIT**	**OUTFIT**	**COHERENCE**			**EST IM**	
LABEL	SCORE	COUNT%	AVRGE	EXPECT	MNSQ	MNSQ	M ->C	C->M	RMSR	DISCR	
1	1	338 13	-1.28	-1.26	.99	1.03	64%	11%	1.1952		1
2	2	717 28	-.69	-.67	.93	.93	44%	50%	.7168	1.04	2
3	3	786 30	-.12	-.15	.77	.73	43%	69%	.4991	1.14	3
4	4	576 22	.040	.36	.95	1.04	49%	37%	.8812	.99	4
5	5	187 7	.87	1.03	1.28	1.43	65%	11%	1.5533	.88	5

OBSERVED AVERAGE is mean of measures in category. It is not a parameter estimate.

In the above table, it is known the mean observed average value moves, ie from the smallest logit value -1.28 logit to the positive +87 logit. The coherence value of the measurement reflecting whether the measurement is influenced by the category of answer or otherwise (M➔C, dan C➔ M) shows the stability of the percentage value.

3.4 Separation Index

Grouping person and items are needed to map how much the ability of the instrument classifies the distribution of items and persons when Smartphone Addiction is administered. Based on the separation index, it is known items can differentiate the ability of items into five groups (4.86) from the range of items very easily, easily, enough, difficult, and very difficult. However, the estimate of the separation index item is not followed by the separation index person value where the ability of the instrument to classify the person is only three groups (2.83).

3.5 Item Fit and Item Difficulty

In the Rasch analysis, estimates of difficulty items aim to look at items that have difficult or easy levels for respondents. Analysis of 31 items in Smartphone Addiction Inventoryfound that item number 17 (+1.76 logit) was the most difficult item to be approved by all respondents. Meanwhile, item number 26 (-2.11 logit) is the easiest item to be approved by all respondents. Summary of the distribution of difficulty level felt by respondents in Smartphone Addiction Inventoryis presented in Table 2.

Table 3. Constructing Examinations from Calibrated Item, Item Difficulty, and Item Fit of the Smartphone Addiction Inventory(N=84, Item=31)

Item Number	Measure	INFIT MSNQ	OUTFIT MSNQ	Perceived Difficulty
17	1.76	1.58	1.75	Item too Difficult
19	1.29	1.54	1.37	
30	.92	2.02	2.53	
31	.75	1.15	1.08	
23	.54	.93	.94	
22	.44	.70	.70	
4	.41	1.13	1.13	
10	.23	.53	.55	
16	.20	.89	.90	
14	.18	.92	.92	
11	.17	.90	.90	
18	.17	.94	.97	
21	.15	.91	.95	
3	.08	1.49	1.49	
5	.05	1.03	1.01	
1	.03	.59	.60	
2	.00	.94	1.03	
12	.00	.75	.75	MPS
20	-.06	.64	.62	
8	-.17	.65	.65	
13	-.22	.50	.50	
28	-.28	.46	.47	
27	-.35	1.38	1.37	
15	-.41	3.11	3.46	
25	-.46	1.08	1.07	
7	-.49	.43	.43	
29	-.52	.71	.72	
9	-.58	.79	.81	
6	-.65	.66	.67	
24	-1.08	.89	.88	
26	-2.11	.96	.94	Item too Easy

Item calibration, INFIT MSNQ, and OUTFIT MSNQ in Logit
MEAN INFIT MNSQ = 1.01, MEAN OUTFIT MNSQ = 1.04
MEAN INFIT ZSTD = -.4, MEAN OUTFIT ZSTD = -.3
MEAN Item = .00, S.D. Item = .69

Table 3 also shows the estimate of the fit items by looking at whether the average sensitivity of the answer pattern (INFIT MNSQ), and the sensitivity of the difficulty level (OUTFIT MNSQ) of all persons reflects the measurement implications well. The item fit analysis in Smartphone addiction Inventory is known that item number 17, 30, 28, 15 and 7 have INFIT and OUTFIT MNSQ values that exceed the ideal measurement range, + .50 logit - +1.50 logit. This indicates that although it does not degrade the quality of the measurement, the five items are not good enough to be used in Smartphone addiction Inventory.

The result is different from the condition of 26 other items, where the INFIT and OUTFIT MNSQ values do not exceed the range of + 50 logit - +1.50 logit. This indicates that only 26 items have good conditions for measurement. Furthermore, the average estimate of INFIT and OUTFIT ZSTD at Smartphone addiction Inventory is -2 logit - +2 logit. This indicates that the Smartphone Addiction Inventory data still has logical measurement estimates.

3.6 Test Information Function

The measurement information of the instrument focuses on measurement focus. The information generated in this test depends on the relationship between the tests given and the individual abilities given the tests. The X axis shows students'abilities while the Y axis explains the amount of information obtained.

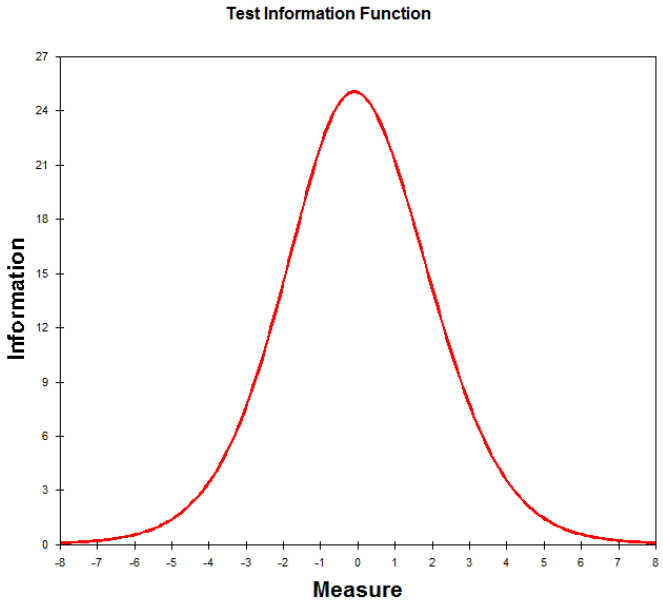

Figure 1. Measurement information function

In the figure above it is known at the low student ability levels the measurement information presented is also low. This is the same in the high student abilities level where the measurement information presented is also low. In contrast, large measurement information was found in respondents who had moderate abilities. Thus this instrument is superb if given to respondents who have abilities that are only, and unsuitable for respondents who have low or high abilities.

4. Conclussion

Based on the above description it can be concluded that the Smartphone Addiction Inventory instrument meets the validity and reliability requirements of the instrument. This means that the Smartphone Addiction Inventory instrument can measure student's smartphone addiction. The existence of this instrument is expected to identify and facilitate in recognizing the addiction of smartphones.

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