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Validity and Reliability Tests on the Nomophobia Instrument with the Rasch Model

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Abstract. *Nomophobia (the fear of being disconnected from a smartphone) severely impacts social and mental problems in society, so it is essential to measure the nomophobia levels to anticipate more severe problems in society. Even so, the validated nomophobia instrument still needs to be looked at to see how it can be used in the current situation. This study, therefore, aims to assess and develop a valid and reliable nomophobia instrument. This research method used a survey approach conducted on 75 students in West Java. Data analysis to test validity and reliability employed Rasch modeling with Winstep, consisting of 1) item and person reliability validity testing, 2) Wright Map person and item instruments, 3) rating scale analysis, and 4) exploratory analysis factors. Then, to find out the level of nomophobia among college students, descriptive statistical analysis was applied. The analysis results revealed that out of 15 instruments, 11 had the feasibility to be used in measuring the nomophobia construct with four dimensions: 1) the dimension of loss of connectedness, 2) the dimension of giving up convenience, 3) the dimension of inability to communicate, and 4) the dimension of inability to access information. Meanwhile, for instrument answers, the Nomophobia scale score is recommended to be ranked from 1 to 4.*

Keywords: *nomophobia; instrument validity; rasch model.*

INTRODUCTION

The intensity of using mobile phones increases due to the demands of education, work, and meeting daily communication needs. It undoubtedly can impact a person's behavior, either directly or indirectly. The impact of excessive use of smartphones, of course, also impacts psychological and social problems in individuals.

One of the impacts that can arise from using mobile phones with high intensity is the occurrence of nomophobia or no mobile phone phobia. The term no-mobile-phone phobia is defined as the fear of not being able to use or reach a smartphone (Yildirim & Correia, 2015). Nomophobia is often characterized by problems related to controlling self-satisfaction with the

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functions or facilities provided by the mobile phone so that, in the end, an individual who experiences nomophobia loses self-discipline (Bhattacharya et al., 2019; Farchakh et al., 2021; Gonçalves et al., 2020). The concept of nomophobia involves at least three things: loss of access to information, loss of connectedness, and loss of communication skills (King et al., 2013; Yildirim & Correia, 2015). Furthermore, nomophobia is a particular condition aroused by situations where the potential unavailability of one's smartphone arises. Ildirim & Correia (2015) also revealed that nomophobia consists of four aspects, i.e., not being able to communicate, losing connectedness, not being able to access information, and giving up convenience.

Most nomophobia instrument testing was carried out using confirmatory factor analysis. Testing (López -Torrecillas et al., 2019; Hernández & Moya, 2022) has also been performed using the NMP-Q questionnaire modification instrument developed (Yildirim & Uk, 2014). In addition, the CFA test distributed to students in Mexico uncovered that of the 20 nomophobia instrument items, 15 had good validity and were divided into three dimensions: not being able to communicate, losing connectedness, and not being able to access information.

Meanwhile, other researchers (López -Torrecillas et al., 2019) tested 11 nomophobia items of a new Questionnaire to Assess Nomophobia (QANP) from a systematic review (Beranuy-Fargues et al., 2009; Bianchi & Phillips, 2005; Billieux et al. ., 2008; Chóliz, 2012; Chóliz et al., 2016; Güzeller & Coşguner, 2012; Ha et al., 2008; Igarashi et al., 2008; Jenaro et al., 2007; Kwon et al., 2013; Leung, 2008; López-Fernández et al., 2012; Martinotti et al., 2011; Merlo et al., 2011; Rutland & Sheets, 2007; Toda et al., 2004; Yildirim & Correia, 2015). The analysis results disclosed that the 11 items had good validity and were spread over three dimensions. The validity test, which was carried out (López -Torrecillas et al., 2019), used confirmatory factor analysis.

Various instrument validity and reliability tests can be performed. Generally, the instrument test carried out for a long time is the classical test, where the value of the respondent's responses is treated as interval data. The interval test corrects the view that respondents' responses should be treated as ordinal data, and analysis with Rasch makes it possible to obtain interval data (Aghekyan, 2020; Wang et al., 2006).

The Rasch model is a single-parameter model, whereas most other models from the IRT variety are two or three-parameter models (Boone & Scantlebury, 2006). Like exploratory and confirmatory factor analysis, the Rasch model measures latent variables. However, unlike factor analysis, Rasch analysis considers the "person's ability" and "item difficulty" strands. Hence, these concepts are quite evident when applied to knowledge-based tests, which have different meanings for attitude and opinion measurement tools (Aghekyan, 2020; Sjaastad, 2014).

Although researchers need more time to perform data validity using Rasch analysis than with traditional analysis, the results are more promising since they provide a deeper understanding, accurate results, and information about the strengths and weaknesses of the instrument in its use (Aghekyan, 2020; Boone & Scantlebury, 2006). Besides, the analysis results using the Rasch model can change ordinal data from a Likert scale survey to interval scale data. It will be in hypothesis testing with parametric statistical tests, such as the t-test and ANOVA. Of course, it is hugely different from CFA, which focuses on the covariance between test items and item response theory (IRT), including the Rasch model, which aims to test item responses (Aghekyan, 2020).

Based on the background above, nomophobia seriously impacts social and mental problems in society, so measuring the high number of nomophobia is vital to anticipate more severe societal problems. However, the lack of evaluation of a validated nomophobia instrument is a significant obstacle in identifying the level of nomophobia among college students. For this reason, this study aims to develop and validate the nomophobia instrument using the Rasch model.

METHOD

This research was designed as quantitative with a survey method. Meanwhile, the first stage in this study was to adapt the instrument according to the nomophobia concept (Yildirim & Correia, 2015), comprising four instrument dimensions: not being able to communicate, losing connectedness, not being able to access information, and giving up convenience. In conducting validity and research instrument development, the Rasch method has good performance for validating the instrument by examining how well all items work together in representing the underlying construct and, therefore, provides additional construct validation (Fortus & Vedder-Weiss, 2014).

In instrument testing and instrument development, several usually carried out stages include conducting direct testing of research instruments according to the concept or conducted by developing instrument items. The questionnaire tested in this study was by carrying out a systematic review that had been developed (López -Torrecillas et al., 2019), which consisted of 11 items covering three dimensions: (a) not being able to communicate, (b) losing connectedness, and (c) not being able to access information. In addition, testing this instrument added a dimension of giving up convenience (Yildirim & Uk, 2014).

Furthermore, conducting a Rasch analysis usually involves examining instrument modeling properties: 1) analysis of item validity and person (testing targeting) tests, aiming to determine whether the instrument is on target. In addition, this test can determine the degree of discrimination of the instrument against the respondent. Moreover, 2) the person separation test is used to evaluate the instrument's reliability and monitor its continued effectiveness. The segregation of persons indicates how effective the instrument is in the segregation of the persons being measured. Likewise, item separation demonstrates how well a sample of people can separate the items used in the instrument. The statistics provided by the Rasch analysis also show how well the test separates respondents and ranks them (Aghekyan, 2020; Jørgen Sjaastad, 2014). In this test, the separation test and the Wright Map person and item instrument test are conducted. Besides, the next test performed in the Rasch analysis is 3) the rating scale test and dimensionality test (Aghekyan, 2020). The dimensionality test is a necessary test to do even though it adopts existing research instruments. It is because many tests expose different dimensionality based on diverse groups or characteristics of respondents (Elyasi et al., 2018a, 2018b; Lin et al., 2018; Rangka et al., 2018).

The population of this study was undergraduate students at the Faculty of Communication Sciences, Padjadjaran University, totaling 2,852 students spread across seven study programs (Pendidikan & Kebudayaan, 2021). The sampling technique employed was convenience sampling, with an error rate (of a=11%). Meanwhile, the number of samples obtained was 75 students.

In this study, the data analysis test utilized the Rasch model test with Winsteps and SPSS software. The Rasch test was conducted to test the validity and reliability of items and persons. Tests with Rasch modeling included (1) testing the validity of the reliability of items and persons (this analysis aimed to find out how valid and reliable items and persons were in measuring the nomophobia instrument); (2) analysis of the Wright Map of persons and instruments (this analysis was to look at the logit of the instrument and the difficulty level of the instrument); (3) rating scale analysis (this test was intended to find out how well respondents could understand the answer scale); (4) dimensionality test (this test was carried out with factor analysis utilizing SPSS). Specifically, this analysis's purpose was to identify the nomophobia dimensions

RESULTS AND DISCUSSION

Nomophobia Instrument Development and Validity

This study evaluated the nomophobia instrument developed by Yildirim & Correia (2015) with some adjustments. A total of 15 instrument items were developed. This test was conducted to determine how well the instrument explained the nomophobia concept. The instruments were distributed to 75 respondents and tested using Rasch modeling analysis.

Instrument validity refers to the extent to which an assessment instrument is relevant and representative in measuring the concept it is designed to measure (Rusticus, 2014). On the other side, Rasch is a statistical test to determine the extent to which instrument items fit the model and the concept being measured (Boone et al., 2014). Testing in this research included the extent to which item and person instruments had good validity in measuring the nomophobia concept. The analysis results of the instrument validity, in general, are described in Table 1.

Table 1.
Summary of person and item statistical validity tests

Parameter	Person	Item
N	75	15
Measures (logit)		
Max	3.14	1.63
Min	-1.14	-1.65
SD (standard deviation)	0.75	0.00
SE (standard error)	0.11	0.23
Outfit mean-square		
Mean	0.96	0.96
SD	-0.2	-0.2
Separation	2.35	5.78
Reliability	0.85	0.97
Cronbach's Alpha	0.86	

Source: Research data analysis

To see the quality of the instrument, this study developed the instrument by surveying 75 student respondents. Several parameters can be seen in Table 1. Based on Table 1, the overall Cronbach's alpha reliability value was 0.86. It reveals that the interaction between the person and item instruments as a whole had good quality. The analysis also showed that the person reliability value was 0.85, and the item reliability was 0.95. These values indicate that the consistency of respondents' answers and the quality of the item instrument were very good. Another value showing how well the item instrument was in measuring the concept was the maximum and minimum values of the measures. Based on the logit value, the size distribution was extensive throughout the logit scale in item difficulty levels. It implies that the instrument could measure a broader spectrum of individual abilities in answering the nomophobia instrument. In addition, the separation value from the analysis results uncovered a value of more than 1, which was 2.35. It suggests that the number of samples was sufficient to separate individual abilities (Gracia, 2005).

Meanwhile, whether the instrument and person fit in describing the concept can be seen from several parameters. The first is the outfit mean square value, then the standard outfit Z-value,

and finally, the point measure correlation value. The instrument is said to be fit if all three parameters are categorized as fit. From the data analysis results, the MNSQ value was 0.96 (SD: 0.2), indicating that the average nomophobia concept measurement instrument was in the fit category, with a value of 0.5 < MNSQ < 1.5 (Boone et al., 2014).

Table 2.
The values of a measure, infit MNSQ, Outfit MNSQ, ZSTD, and Pt-measure correlation from the nomophobia instrument

Item	Measure	Infit MNSQ	Outfit MNSQ	Outfit ZTSD	Pt-Measure Corr
Q1	-0.42	0.80	0.83	-0.96	0.60
Q2	-0.59	0.78	0.71	-1.62	0.65
Q3	-0.30	1.13	1.10	0.60	0.58
Q4	0.58	0.69	0.67	-2.38	0.72
Q5	-0.40	0.68	0.65	-2.14	0.65
Q6	0.27	1.41	1.35	2.05	0.61
Q7	0.89	1.39	1.36	2.12	0.50
Q8	-0.19	0.74	0.73	-1.69	0.64
Q9	1.63	1.10	1.12	0.78	0.50
Q10	0.17	1.07	1.04	0.31	0.62
Q11	-0.55	1.21	1.02	0.16	0.61
Q12	-1.08	1.09	0.98	-0.03	0.50
Q13	-1.65	0.88	0.78	-0.76	0.41
Q14	1.33	1.11	1.17	1.07	0.56
Q15	0.33	0.98	0.95	-0.27	0.65

Source: Research data analysis

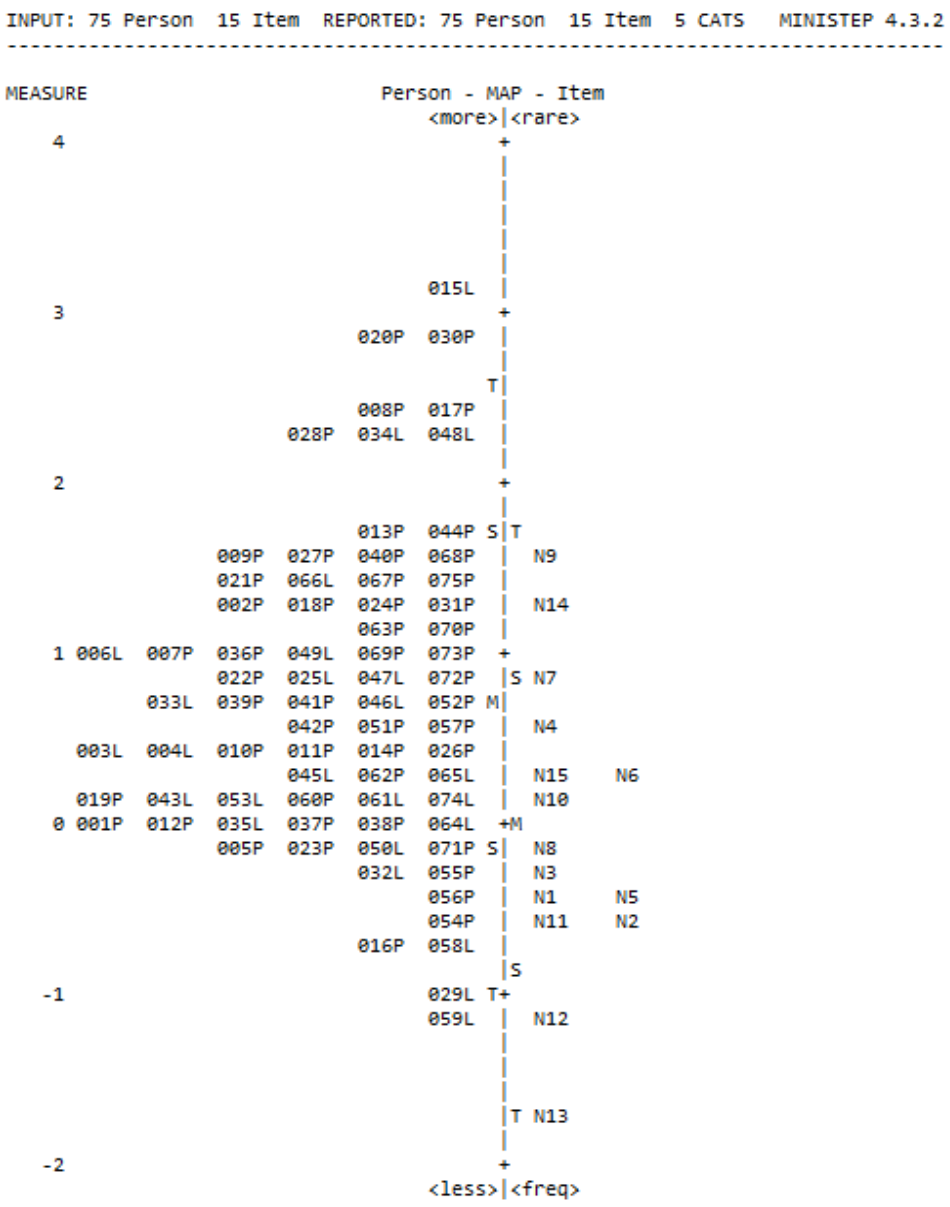
In Table 2, overall, the research instruments had good MNSQ outfit values and were in the area of acceptance/fit. For the ZSTD outfit, the value is categorized as fit if it is in the range -2 < ZSTD < 2. However, the analysis results of several items had misfit values. Meanwhile, the MNSQ outfit values (Q1, Q3-Q15) were still in the value range of 0.5 < MNSQ < 1.5. It implies that the instrument was classified as fit (Boone et al., 2014). Likewise, with the Pt-measure Correlation value, all instruments were classified as fit (Sumintono, 2014). Based on the analysis results, it is known that most instruments had good validity. Nevertheless, four instruments experienced a misfit in the ZSTD outfit parameters: Q4, Q5, Q6, and Q7. At a later stage, the misfit instruments were not included in the follow-up analysis.

The results of this study indicate a difference in the validity of the questionnaire proposed (Hernández & Moya, 2022; Yildirim & Uk, 2014) to measure nomophobia, which found 20 valid items with three nomophobia dimensions. Meanwhile, other studies (Elyasi et al., 2018; Yildirim & Uk, 2014) removed the last question item. In this measure, the difference in the items' validity was caused by different respondents' characteristics between the two countries.

Analysis of Wright Map Person and Instrument Items

To find out the distribution of the difficulty level of questions or instruments and the distribution of students' or respondents' abilities, it can be illustrated with a Wright Map. Figure 1 explains the distribution of instrument difficulty levels and students' ability to answer the

instrument on a logit ratio scale. The item difficulty level is depicted on the right side, while the student's answering ability level is on the left side of the figure. From Figure 1 above, it is also known that students' abilities in answering research instruments were relatively diverse, which could be observed from the size of the logit value scale. Large logit values refer to difficult questions to answer or agree on; conversely, a low logit bar value indicates an easy instrument to be answered or agreed upon by respondents. Instruments 13 and 12 (N13, N12) were the easiest nomophobia questions to answer or agree with, whereas instrument number 9 (N9) was the most difficult question to be answered for respondents. The value of these various answers could relatively show that the instrument had relatively good discriminatory power.



Source: Research data analysis

Figure 1.
Persons measured and test items displayed on the same logit scale

These findings demonstrate that, overall, the question items were good enough to measure and evaluate the homophobia levels among college students. Question items were also spread from easy, medium, and difficult questions. In other words, this instrument item was quite good at discriminating against respondents. The same thing has also been revealed (Rangka et al., 2018) that the nomophobia instrument items must have various difficulty levels, making it possible to discriminate against the respondent's abilities.

Rating Scale Analysis

The rating scale analysis test aimed to evaluate whether respondents could distinguish the choice of instrument answers well. In this study, the scale used was a Likert scale from 1 to 5: 1) strongly disagree [SD], 2) disagree [D], 3) neutral [N], 4) agree [A], 5) strongly agree [SA]. The rating scale analysis results are depicted in Figure 2.

SUMMARY OF CATEGORY STRUCTURE. Model="R"

CATEGORY LABEL	SCORE	OBSERVED COUNT	%	OBSVD AVRGE	SAMPLE EXPECT	INFIT MNSQ	OUTFIT MNSQ	ANDRICH THRESHOLD	CATEGORY MEASURE	
1	1	78	7	-.83	-.95	1.14	1.11	NONE	(-2.77)	1
2	2	184	16	-.35	-.32	.93	.87	-1.49	-1.07	2
3	3	236	21	.30	.32	1.01	.99	-.24	.04	3
4	4	299	27	.98	1.00	.97	.86	.42	1.09	4
5	5	327	29	1.87	1.84	1.03	1.01	1.31	(2.65)	5
MISSING		1	0	2.87						

Source: Research data analysis

Figure 2.
Summary of category structure/rating scale

The table above presents that the observed average value was in a good category since, from the lowest scale (-0.83) to the highest scale (1.87), it increased. Meanwhile, the respondent's ability to identify differences in scale can be described in the Andrich threshold column below:
1.The distance between score 1 (SD) and score 2 (D) is 0 - (-1.49) = 1.49.
2.The distance between score 2 (D) and score 3 (N) is (-1.49) - (-0.24) = 1.25.
3.The distance between score 3 (N) and score 4 (A) is (-0.24) - (0.42) = 0.66.
4.The distance between score 4 (A) and score 5 (SA) is (0.42) - (1.31) = 0.89.

The Andrich threshold analysis results revealed that based on the distance between scales, it was detected that respondents could not fully differentiate between scales since the Andrich threshold index was partly less than 1.4. The scale must be combined or simplified if the index is less than 1.4 (Sumintono, 2014). Besides, from the MODES - Andrich thresholds at intersections figure, the most prominent answer choices out of the five choices were STS, TS, S, and SS.

These results found that the answers to the instrument items should be simplified into four item choices, in line with the view (Sumintono, 2014). Meanwhile, in another view (Rangka et al., 2018), five rating scales were still used, even though the analysis results showed an Andrich threshold index partially less than 1.4.

Factor Exploratory Analysis

To find out the nomophobia dimensions, this study conducted further instrument testing,

i.e., PCA (Principal Component Analysis), using a factor analysis test on 11 valid instruments. In the matrix factorability analysis, in the initial stages, Bartlett's test was performed to examine partial correlations aside from bivariate correlations. In addition, the Kaiser–Meyer–Olkin test (KMO) was used to assess the adequacy of sampling in the analysis. Barlett's test uncovered a significant result (v2(75) = 278.665, p< 0.01), rejecting the null hypothesis that the correlations in the matrix were zero and the matrix was an identity matrix. In terms of sampling adequacy, the KMO test showed an index of 0.731, higher than the minimum value requirement (0.60) (Tabachnick & Fidell, 2013).

Table 3.
Eigenvalues and rotational loading results

Factor	Initial eigenvalues			Rotation sums of squared loadings		
	Total	% of variance	Cumulative	Total	% of variance	Cumulative
Factor 1	4.088	37.161	37.161	2.283	20.757	20.757
Factor 2	1.262	11.474	48.635	1.906	17.327	38.084
Factor 3	1.149	10.447	59.082	1.743	15.845	53.929
Factor 4	1.048	9.532	68.614	1.615	14.685	68.614

Source: Research data analysis

From the analysis results, four factors/dimensions of nomophobia had an eigenvalue of more than 1. These four factors could explain 68.614 % of the variants extracted, with an initial eigenvalue greater than 1 (see Table 3). Subsequent tests were carried out using a varimax rotation to improve the interpretation of the four factors. The analysis results after factor I rotation (the dimension of loss of connectedness) contributed 20.75% of the item variance; factor II (the dimension of being unable to communicate) contributed 17.32% of the item variance; factor III (the dimension of giving up convenience) contributed 15.85% of the item variance; factor IV (the dimension of not being able to access information) contributed 14.68% of the item variance. Based on the proportion of the substance of the variants of each factor, it can be concluded that these four factors are essential in explaining the nomophobia concept.

Table 4.
The loading factor values for each instrument

Instrument	1	2	3	4
Q1	0.904	0.056	0.124	0.130
Q2	0.749	0.183	0.223	0.177
Q3	0.602	0.308	0.118	0.076
Q8	0.239	0.233	0.815	-0.091
Q9	-172	0.176	0.549	0.490
Q10	0.304	-0.015	0.770	0.203
Q11	0.239	0.612	0.237	0.343
Q12	0.205	0.747	0.195	0.007
Q13	0.088	0.833	-0.029	0.029
Q14	0.165	-0.014	0.065	0.852
Q15	0.478	0.249	0.066	0.654

Source: Research data analysis

The loading factor values for each dimension/factor are described in Table 4. Based on the table, the loading factor values for each group were more significant than 0.5. It suggests that all instruments were very good at describing the nomophobia dimensions.

Based on the factor exploration analysis results, the eleven research instruments could be grouped into the following four dimensions (see Table 5): 1) Dimensions of Loss of Connectedness (Q1, Q2, and Q3), 2) Dimensions of Giving Up Convenience (Q8, Q9, and Q10), 3) Dimensions of Being Unable to Communicate (Q11, Q12, and Q13), 4) Dimensions of Not Being Able to Access Information (Q14 dan Q15)

Dimensions of Loss of Connectedness (Q1, Q2, and Q3)

Loss of connectedness or connectivity is a feeling related to feelings of loss when unable to connect to services on a mobile phone, such as loss of internet signal connectivity or Wi-fi network, resulting in an inability to check or update on social media. The instruments of this dimension consist of: (i) I will feel very down if my mobile phone is broken; (ii) I feel down if I do not have a mobile phone; (iii) I do not think I can do much without my mobile phone.

Dimensions of Giving Up Convenience (Q8, Q9, and Q10)

The giving up convenience dimension relates to feeling uncomfortable when unable to be near a mobile phone. The instruments for this dimension comprise: (i) I often use my mobile phone more than I need to; (ii) I get angry or annoyed when someone disturbs me while using a mobile phone; (iii) I tend to lose track of time when using my mobile phone.

Dimensions of Being Unable to Communicate (Q11, Q12, and Q13)

The dimension of being unable to access information is a feeling of discomfort when unable to contact or be contacted via mobile phone. The instruments of this dimension encompass: (i) as soon as I wake up in the morning, the first thing I do is check my mobile phone; (ii) when I feel lonely, I use my mobile phone to make calls, send messages, open social media, and others; (iii) I often use my mobile phone to call, send messages, or open social media.

Dimensions of Not Being Able to Access Information (Q14 dan Q15)

The dimension of being unable to access information is a feeling of discomfort when unable to access or obtain information via a mobile phone. The instruments for this dimension are composed of: (i) I sometimes feel anxious if I do not receive messages, calls, or notifications from my social media, and (ii) if I do not have my mobile phone with me, I feel uncomfortable because I cannot check social media.

This study tested the instrument results from a systematic review (López -Torrecillas et al., 2019) and added one dimension to the nomophobia concept developed (Yildirim & Uk, 2014), i.e., giving up convenience. The results of this study revealed that the three dimensions developed (López -Torrecillas et al., 2019) and added one dimension of giving up convenience (Yildirim & Uk, 2014) make the nomophobia instrument consist of 11 items with four dimensions of nomophobia.

This study supports several other studies (Hernández & Moya, 2022), which tested the nomophobia instrument and revealed that nomophobia could be grouped into three dimensions: not being able to communicate, losing connectedness, not being able to access information, and a study by (López -Torrecillas et al., 2019). Furthermore, this study added one dimension of giving up convenience taken from (Yildirim & Uk, 2014) into four items. Of the four items, all were reported to have validity and reliability, which were good fit/supported by the concept (Yildirim & Uk, 2014).

Table 5.
The four-dimensional instrument of nomophobia

Instrument	Question	Dimension
Q1	I will feel very down if my mobile phone is broken.	Loss of Connectedness
Q2	I feel down if I do not have a mobile phone.	
Q3	I do not think I can do much without my mobile phone.	
Q8	I often use my mobile phone more than I need to.	Convenience
Q9	I get angry or annoyed when someone disturbs me while using a mobile phone.	
Q10	I tend to lose track of time when using my mobile phone.	
Q11	As soon as I wake up in the morning, the first thing I do is check my mobile phone.	Being Unable to Communicate
Q12	When I feel lonely, I use my mobile phone to make calls, send messages, open social media, and others.	
Q13	I often use my mobile phone to call, send messages, or open social media.	
Q14	I sometimes feel anxious if I do not receive messages, calls, or notifications from my social media.	Not Being Able to Access Information
Q15	If I do not have my mobile phone with me, I feel uncomfortable because I cannot check social media.	

Source: Research data analysis

Research Limitations

This research has several limitations. This research was conducted only on a small group of Padjadjaran University students. In addition, the sampling technique used was convenience sampling, so it could not represent college student groups in Indonesia in general. For this reason, future research is expected to use probability sampling techniques with larger sample sizes. Moreover, the distribution of instrument items in this study was relatively unbalanced. Hence, it needs further development to build better items.

CONCLUSION

Nomophobia is one of the individual problems currently. Nomophobia seriously impacts social and mental problems in society, so measuring the high number of nomophobia is crucial to anticipate more severe societal problems. For this reason, the study tested the nomophobia instrument and assessed the nomophobia levels among college students.

The analysis results demonstrated that from testing 15 instruments, only 11 had the feasibility to be used in measuring nomophobia, while the remaining four were not good enough to be used in measuring nomophobia. Based on the overall reliability value of Cronbach's alpha of 0.86, the interaction between the person instrument and the items as a whole can be considered good quality. The analysis results also showed that the value of person reliability was 0.85, and item reliability was 0.95. These values indicate very good consistency of the respondents' answers, likewise for the quality of the item instruments. In addition, the outfit means square value, the standard outfit Z-value, and the point measure correlation value revealed good validity, except for instruments Q4, Q5, Q6, and Q7. For the rating scale test, it was found that the respondents were only good enough at distinguishing the rating scale when the scale was from 1 to 4. Furthermore, based on the dimensionality test, the nomophobia dimension consists of four dimensions: loss of

connectedness, convenience, unable to communicate, and unable to access information.

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