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Measuring the National Digital Identity Initiative in Malaysia: A Pilot Study with Rasch Measurement

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ABSTRACT

This pilot study aimed to measure the level of public awareness, perception and acceptance of the National Digital Identity Initiative (NDII) in Malaysia using a validated research instrument. The research instrument underwent a comprehensive validation process, including expert validation and Rasch measurement analysis. A mixed-methods research design was used, including qualitative and quantitative data collection methods. Convenience sampling was used to select a sample of 43 participants aged 18 years and older who have access to the internet. Data was collected using a self-administered questionnaire that contained closed-ended questions with Likert scale response options. The results of the descriptive statistics showed that participants' awareness of the NDII was low, while perception and acceptance was relatively high. The results of the study provide useful insights for policy makers and practitioners in the field and highlight areas for improvement in the implementation of the NDII. The use of Rasch measurement to validate the research instrument increases the validity and reliability of the study findings and enhances their relevance to the field. This pilot study contributes to the body of knowledge on public awareness, perception and acceptance of the NDII, especially in the Malaysian context. Future research can build on the findings of this study by conducting larger studies and exploring the factors that influence public acceptance of NDIIs in Malaysia.

1. Introduction

Digital identity initiatives (DII) are being implemented by governments around the world to promote secure and efficient online transactions, and Malaysia is no exception. The National Digital Identity Initiative (NDII) is a key component of Malaysia's digital transformation agenda, which aims to provide a trusted and secure digital identity system for citizens and businesses to access online

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services. However, the successful implementation of the initiative depends on public awareness, perception and acceptance of the system.

The lack of public acceptance is one of the biggest challenges for DII worldwide. Previous studies have shown that public perception and acceptance of DII is influenced by various factors such as privacy concerns, security risks and the perceived benefits of such initiatives [1,2]. Assessing public awareness, perception and acceptance of NDII in Malaysia is critical to its successful implementation. This pilot study aims to fill this research gap by measuring these factors using a validated research instrument. However, ensuring the reliability and appropriateness of the instrument is a major challenge.

To overcome this challenge, the research instrument underwent a comprehensive validation process that included expert validation and validity and reliability testing using Rasch measurement analysis. This approach is commonly used to assess the psychometric properties of questionnaire items, including their goodness of fit, one-dimensionality and response category function [3,4]. The resulting research instrument consists of several items that holistically assess the public's awareness, perception and acceptance of the NDII, covering various facets of the benefits, drawbacks and potential impact of the initiative.

It is expected that the results of this pilot study will contribute significantly to the knowledge base on public awareness, perception and acceptance of the NDII in Malaysia. The study will also provide insights into the effectiveness of the implementation of the NDII and identify areas for improvement. The use of Rasch measurement to validate the research instrument enhances the validity and reliability of the study findings, which increases their relevance to policy makers and practitioners in the field. Overall, this study is critical to the successful implementation of the NDII and similar initiatives in Malaysia and beyond.

2. Literature Review

The NDII is a digital system that provides a secure and reliable way for individuals to authenticate their identity in online transactions and interactions with government and private sector organisations [1]. The aim is to provide a single digital identity for each person, based on their personal information and biometric data, that can be used across different online services and platforms [5]. The NDII includes a number of components such as identity verification processes, digital identity credentials and authentication mechanisms that work together to ensure the integrity and protection of personal data and transactions [6-8].

Despite the potential benefits of NDIIs, their implementation has faced challenges in various countries. In India, for example, the implementation of the Aadhaar project faced legal challenges due to privacy concerns [9,10]. In the United States, the implementation of the Real ID Act faced resistance due to privacy concerns and government overreach [11,12]. In the United Kingdom, the implementation of the Verify system was criticised for its slow uptake and high cost [13]. The implementation of DII depends on the level of public acceptance and perception, which can be influenced by various factors such as privacy concerns [14-16], perceived benefits [17] and demographic factors [18]. Several studies have examined the influence of these factors on the uptake of DII in different countries, including Thailand, Latvia, Bulgaria, Norway, Germany, Estonia and Australia [19-22]. These studies found that factors such as perceived control over personal data, privacy and data protection, and perceived benefits such as convenience, efficiency, security and fraud prevention can influence public acceptance of DII. Demographic factors such as age, gender, education and income level also play a role in public acceptance of NDII [23,24].

However, in the Malaysian context where the NDII is yet to be fully implemented, there is limited knowledge on the level of public awareness, perception and acceptance of the initiative. The aim of this pilot study is therefore to measure the level of public awareness, perception and acceptance of the NDII using a research instrument that has been developed and tested to ensure its suitability. While previous studies have validated research instruments using various methods, there is a lack of previous studies that have used Rasch measurement in pilot studies to assess the suitability of research instruments to measure the level of public awareness, perception and acceptance of the DII.

3. Methodology

3.1 Research Design

This study used a mixed methods research design that included both qualitative and quantitative data collection methods. The research instrument used in this study was developed based on a comprehensive review of existing literature on DII and expert validation.

3.2 Sampling

The sample for this pilot study consists of 43 participants selected using convenience sampling from the general population of Malaysia. Participants are 18 years and older and have access to the internet.

3.3 Data Collection

Data for this study was collected using a self-administered questionnaire developed based on an extensive review of the relevant literature and previous research. The questionnaire contained closed-ended questions with response options on a Likert scale.

In addition, the research instrument was subjected to expert validation to ensure its content validity. Two experts with extensive experience in DII and survey research were asked to assess the relevance, clarity and completeness of the questionnaire. The experts provided feedback on the content of the instrument and their comments were used to further refine the questionnaire. The research instrument also underwent linguistic proofreading to ensure that the language used was clear and understandable to respondents. The proofreading was done by a professional linguist and necessary changes were made to improve the readability and clarity of the questionnaire.

As part of the validation of the research instrument, the Malaysian Communications and Multimedia Commission (MCMC), which is responsible for the implementation of the NDII, was consulted. The MCMC's input was sought to ensure that the research instrument was in line with the objectives of the initiative and accurately captured its key features. Feedback from the MCMC was integrated into the design of the research instrument to ensure its validity and relevance.

3.4 Data Analysis

The data collected will be analysed by descriptive statistics using the software IBM SPSS. This analysis includes the calculation of summary measures such as median, mode and range to give an overview of the responses collected for each question. The Rasch measurement approach is used to assess the psychometric properties of the questionnaire items, including item fit, one-dimensionality and response category function. This method is widely accepted to assess the adequacy of research

instruments in social science research. The analysis was conducted using Winsteps software version 5.3.4.0. The results of the analysis were used to refine and improve the research instrument.

The research instrument underwent several rounds of review, including validation by subject matter experts, language proofreading and validation by stakeholders. The feedback we received from the experts and the MCMC during these review processes provided valuable comments and suggestions for improving the questionnaire. These comments included recommendations to clarify certain questions, improve the formatting and presentation of the questionnaire and ensure the relevance of the questions to the target population.

3.5 Ethical Considerations

This pilot study has been ethically approved by the Ethics Committee of Universiti Teknologi MARA (UiTM). Informed consent will be obtained from all participants prior to participation in the study. Participants will be informed of their right to withdraw from the study at any time and will be assured that their responses will be kept confidential.

3.6 Limitations

As this is a pilot study, the sample size is relatively small and the results may not be generalisable to the entire population in Malaysia.

4. Results

4.1 Descriptive Statistics

The research instrument developed for this study consists of four main sections: innovativeness, data management, personal security information and awareness, perception and acceptance of NDII. The innovativeness section measures respondents' openness to new technologies, while the data management section assesses their views on managing their identity online. The personal security information section assesses the security of personal data, perceptions of existing personal data protection laws and preferences for identity protectors. The final section of the questionnaire is of most importance as it relates directly to the NDII. It includes questions on awareness, acceptance, perceived usefulness, motivators and methods of promotion. Below is a brief breakdown of the descriptive statistics for each section:

4.1.1 Innovativeness section

The results of the descriptive statistics indicate that respondents have a generally positive attitude towards new and emerging technologies. This is assessed by their agreement with the statements "I am an early adopter of emerging technologies", "I try to adopt new technologies when I hear about them" and "I like to try new technologies".

The median and mode for all three statements were "agree", indicating that a majority of respondents agreed with these statements. The range for each statement was the maximum possible value of 5, indicating that respondents had a wide range of opinions on these issues but generally tended to agree.

4.1.2 Data management section

Respondents were asked about the type of online information they provide and it was found that they felt comfortable sharing their name, age, nationality and pictures of themselves online. However, they were reluctant to disclose sensitive information such as IC, phone number, address, appearance, opinions, people they regularly interact with, places they frequently visit and banking details.

In terms of trust, respondents showed a high level of trust in family members to handle their personal information, but not in friends, federal or state governments or companies. When it comes to sharing personal information for various activities, they were willing to share information to improve services or obtain useful knowledge, but not for autotyping, playing games, socialising, targeted advertising or receiving gifts or samples.

Respondents were very concerned about various risks associated with personal data, including misuse of personal data, monitoring of online behaviour, use of personal data for marketing purposes, reconstruction of identity from personal data sources, misrepresentation of online information, damage to reputation from personal information published online, online identity theft and online financial fraud.

When asked about their knowledge of privacy and security of personal information, respondents showed moderate understanding but disagreed with the statement that the internet is safe for leisure, work and business transactions. They also showed a high level of agreement that they know how to keep their online activities private, but disagreed with the statement that they like to share personal information online because of internet security.

4.1.3 Personal security section

The results indicate that most respondents take personal responsibility for their online safety, with a mode of "yes" for the statement "My online safety is my responsibility." Respondents also indicated that various parties have a duty to protect the safety of online users, with a mode of "yes" for statements such as "The company I do business with must protect my personal information online" and "The police and courts are responsible for protecting personal information online."

When it comes to protecting their personal information and identity online, respondents said they use a variety of practises, such as reading websites' privacy policies, updating antivirus software, and changing browser privacy settings, all with a "yes". Respondents also said they were knowledgeable about privacy and answered "yes" to the question about privacy: are you knowledgeable about it?"

In terms of effectiveness, respondents agreed with statements such as "Service providers must protect their customers' identities" and "Promote secure identity management through formal education" with a "yes", indicating that they consider these approaches to be effective ways to protect their online identity. However, they neither agreed nor disagreed on the statement "My personal data is protected in the country", indicating uncertainty on this question.

Respondents who were asked about their level of agreement with various statements related to personal data management agreed with statements such as "The authorities will always help me if I have problems with my personal data" and "Nationality laws can handle the increase in people putting personal data online". The statement "I feel comfortable sharing my personal data online because the internet is safe", on the other hand, was rated as "disagree", indicating that respondents do not feel completely safe sharing their personal data online.

4.1.4 Awareness, perception and acceptance of NDII section

The survey found that all participants were familiar with different types of identity systems, including passwords/PINs, RFID, biometrics, IP addresses and electronic signatures. However, none of the participants had heard of NDII.

Respondents were asked about the benefits they expected from a service like NDII. Most participants believed that it would provide secure identification and give them control over their personal data, while fewer were certain that the burden on users would be minimal and the cost savings low. In addition, many participants believed that identity fraud could be detected through such a service.

In terms of risks associated with identification systems, most participants were concerned about the potential tracking of their online behaviour, the risk of their private data being compromised through a hack, and unauthorised access to their personal data. Participants also expressed concern about someone else using their identity and fraudulently charging their credit card. Fewer participants were concerned about potentially revealing embarrassing details of their private lives and receiving spam advertisements.

When asked what would attract more users to the NDII service, most participants felt that complete confidentiality, the ability for users to choose what personal information they disclose and the simplification of the sign-up process were the most important factors. In addition, many participants felt that making the service available free of charge, reducing waiting times, checking the system annually and using biometrics to simplify the self-verification process would attract more users.

4.2 The Validity and Reliability

The questionnaire underwent various review processes, including validation by subject matter experts, linguistic proofreading, validity and reliability testing based on data from a pilot study, and approval by the MCMC.

4.2.1 Experts, linguistic proofreading and stakeholder validation

After going through several revision processes, the research tool received positive feedback and constructive criticism from the experts and the MCMC. The feedback from the experts regarding content validity was positive, with suggestions for minor improvements to enhance the clarity and comprehensibility of certain items. Linguistic proofreading resulted in minimal revisions, indicating that the language used in the questionnaire was clear and easy to understand.

Stakeholder validation also yielded valuable feedback, particularly on the relevance and appropriateness of the questionnaire to the target population. Stakeholders' comments and suggestions were considered and resulted in minor adjustments to some questions and the addition of some new questions to better capture respondents' perspectives.

4.2.2 The validity and reliability of the pilot survey

Rasch measurement analysis was used to examine the validity and reliability of questionnaire items designed to measure respondents' awareness, perception and acceptance of digital identity initiatives. This analysis was conducted based on the data from the pilot survey. Various statistical methods were used for the analysis, including Cronbach's alpha, mean squared and principal

component analysis (PCA). The statistical analysis techniques used in this study were used to generate all the results presented. The results of this analysis are discussed in more detail in the following sections. All statistical results were generated using WINSTEPS software.

4.2.2.1 Cronbach's alpha

The findings of the study are presented in Figure 1, which provides important insights into the reliability and validity of the questionnaire items used to assess the awareness, perception and acceptance of digital identity initiatives among Malaysian respondents from diverse backgrounds.

In the innovativeness section, the Cronbach's alpha value of 0.79 indicates a high level of internal consistency among the items, indicating that they are interrelated and measure the same construct. This value is above the acceptable range of 0.6 for a reliable scale with a 95% confidence interval [25], thus indicating a reliable scale. The item's reliability value of 0.9 highlights the reliability of the innovativeness section and indicates a high degree of consistency in measuring what it intends to measure. The accepted Cronbach's alpha value underpins the reliability of the item's score and confirms the results.

SUMMARY OF 38 MEASURED (NON-EXTREME) Persons

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	11.3	3.0	2.16	1.16	.92	-.2	.93	-.2
S.D.	1.7	.0	2.12	.19	1.56	1.1	1.60	1.0
MAX.	14.0	3.0	6.20	1.36	8.69	3.7	8.07	3.0
MIN.	6.0	3.0	-2.84	.86	.12	-1.3	.11	-.9
REAL RMSE	1.38	ADJ.SD	1.60	SEPARATION	1.16	Person RELIABILITY		.57
MODEL RMSE	1.18	ADJ.SD	1.76	SEPARATION	1.49	Person RELIABILITY		.69
S.E. OF Person MEAN = .35								

MAXIMUM EXTREME SCORE: 4 Persons
MINIMUM EXTREME SCORE: 1 PersonsPerson RAW SCORE-TO-MEASURE CORRELATION = .98

CRONBACH ALPHA (KR-20) Person RAW SCORE RELIABILITY = .79

SUMMARY OF 3 MEASURED (NON-EXTREME) Items

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	164.3	43.0	.00	.32	.98	.0	.93	-.2
S.D.	10.8	.0	1.02	.03	.22	.8	.20	.7
MAX.	176.0	43.0	1.32	.35	1.27	1.1	1.17	.7
MIN.	150.0	43.0	-1.16	.28	.76	-.8	.68	-1.1
REAL RMSE	.33	ADJ.SD	.96	SEPARATION	2.94	Item	RELIABILITY	.90
MODEL RMSE	.32	ADJ.SD	.97	SEPARATION	3.05	Item	RELIABILITY	.90
S.E. OF Item MEAN = .72								

UMEAN=.000 USCALE=1.000
Item RAW SCORE-TO-MEASURE CORRELATION = -1.00
114 DATA POINTS. LOG-LIKELIHOOD CHI-SQUARE: 158.59 with 71 d.f. p=.0000

Innovativeness

SUMMARY OF 43 MEASURED Persons

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	65.9	39.0	-2.78	.29	1.00	-.1	1.04	.1
S.D.	7.1	.0	.58	.02	.38	1.5	.60	1.4
MAX.	89.0	39.0	-1.21	.37	1.75	2.5	4.06	5.1
MIN.	50.0	39.0	-4.32	.24	.33	-3.6	.29	-2.9
REAL RMSE	.31	ADJ.SD	.49	SEPARATION	1.59	Person RELIABILITY		.72
MODEL RMSE	.29	ADJ.SD	.50	SEPARATION	1.75	Person RELIABILITY		.75
S.E. OF Person MEAN = .09								

VALID RESPONSES: 99.9%
Person RAW SCORE-TO-MEASURE CORRELATION = .99 (approximate due to missing data)
CRONBACH ALPHA (KR-20) Person RAW SCORE RELIABILITY = .74 (approximate due to missing data)

SUMMARY OF 37 MEASURED Items

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	74.2	43.0	.00	.32	1.06	-.1	1.04	-.2
S.D.	21.5	.0	1.60	.17	.47	2.0	.49	2.0
MAX.	148.0	43.0	3.88	1.01	2.44	4.9	2.49	5.0
MIN.	44.0	43.0	-3.63	.19	.25	-5.0	.25	-5.0
REAL RMSE	.40	ADJ.SD	1.55	SEPARATION	3.84	Item	RELIABILITY	.94
MODEL RMSE	.36	ADJ.SD	1.56	SEPARATION	4.34	Item	RELIABILITY	.95
S.E. OF Item MEAN = .27								

MAXIMUM EXTREME SCORE: 2 Items
UMEAN=.000 USCALE=1.000

Data

SUMMARY OF 42 MEASURED (NON-EXTREME) Persons

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	45.3	28.0	-2.26	.31	.97	.0	1.23	.0
S.D.	6.9	.0	.70	.07	.42	1.1	1.62	1.1
MAX.	60.0	28.0	-1.22	.61	2.03	2.1	9.80	3.1
MIN.	30.0	28.0	-4.46	.21	.13	-2.9	.07	-1.4
REAL RMSE	.34	ADJ.SD	.61	SEPARATION	1.77	Person RELIABILITY		.76
MODEL RMSE	.32	ADJ.SD	.62	SEPARATION	1.93	Person RELIABILITY		.79
S.E. OF Person MEAN = .11								

MINIMUM EXTREME SCORE: 1 Persons

Person RAW SCORE-TO-MEASURE CORRELATION = .93
CRONBACH ALPHA (KR-20) Person RAW SCORE RELIABILITY = .76

SUMMARY OF 28 MEASURED (NON-EXTREME) Items

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	68.9	43.0	.00	.27	1.01	.1	1.23	.2
S.D.	31.0	.0	1.12	.13	.14	.6	.99	1.0
MAX.	141.0	43.0	2.19	.90	1.39	1.8	4.46	2.8
MIN.	44.0	43.0	-2.45	.18	.69	-1.6	.47	-1.2
REAL RMSE	.31	ADJ.SD	1.08	SEPARATION	3.46	Item	RELIABILITY	.92
MODEL RMSE	.30	ADJ.SD	1.08	SEPARATION	3.55	Item	RELIABILITY	.93
S.E. OF Item MEAN = .22								

UMEAN=.000 USCALE=1.000
Item RAW SCORE-TO-MEASURE CORRELATION = -.97
1176 DATA POINTS. LOG-LIKELIHOOD CHI-SQUARE: 1512.14 with 1104 d.f. p=.0000

Personal Security Information

SUMMARY OF 41 MEASURED (NON-EXTREME) Persons

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	50.9	37.0	-1.53	.39	.92	-.1	1.00	.1
S.D.	13.7	.0	1.11	.19	.41	1.2	.87	1.1
MAX.	100.0	37.0	1.34	.85	2.02	2.9	2.93	2.4
MIN.	38.0	37.0	-3.37	.21	.41	-2.1	.07	-1.7
REAL RMSE	.44	ADJ.SD	1.02	SEPARATION	2.29	Person RELIABILITY		.84
MODEL RMSE	.43	ADJ.SD	1.02	SEPARATION	2.37	Person RELIABILITY		.85
S.E. OF Person MEAN = .18								

MAXIMUM EXTREME SCORE: 1 Persons
MINIMUM EXTREME SCORE: 1 Persons

Person RAW SCORE-TO-MEASURE CORRELATION = .94
CRONBACH ALPHA (KR-20) Person RAW SCORE RELIABILITY = .96

SUMMARY OF 37 MEASURED (NON-EXTREME) Items

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	60.4	43.0	.00	.33	1.00	-.1	1.00	.2
S.D.	13.3	.0	.89	.11	.42	.8	.77	.8
MAX.	98.0	43.0	2.27	.86	2.28	1.9	5.04	4.2
MIN.	46.0	43.0	-2.10	.21	.44	-1.5	.29	-1.0
REAL RMSE	.38	ADJ.SD	.80	SEPARATION	2.11	Item	RELIABILITY	.82
MODEL RMSE	.35	ADJ.SD	.81	SEPARATION	2.32	Item	RELIABILITY	.84
S.E. OF Item MEAN = .15								

UMEAN=.000 USCALE=1.000
Item RAW SCORE-TO-MEASURE CORRELATION = -.95
1517 DATA POINTS. LOG-LIKELIHOOD CHI-SQUARE: 1245.39 with 1439 d.f. p=.9999

NDII

Fig. 1. Summary statistics

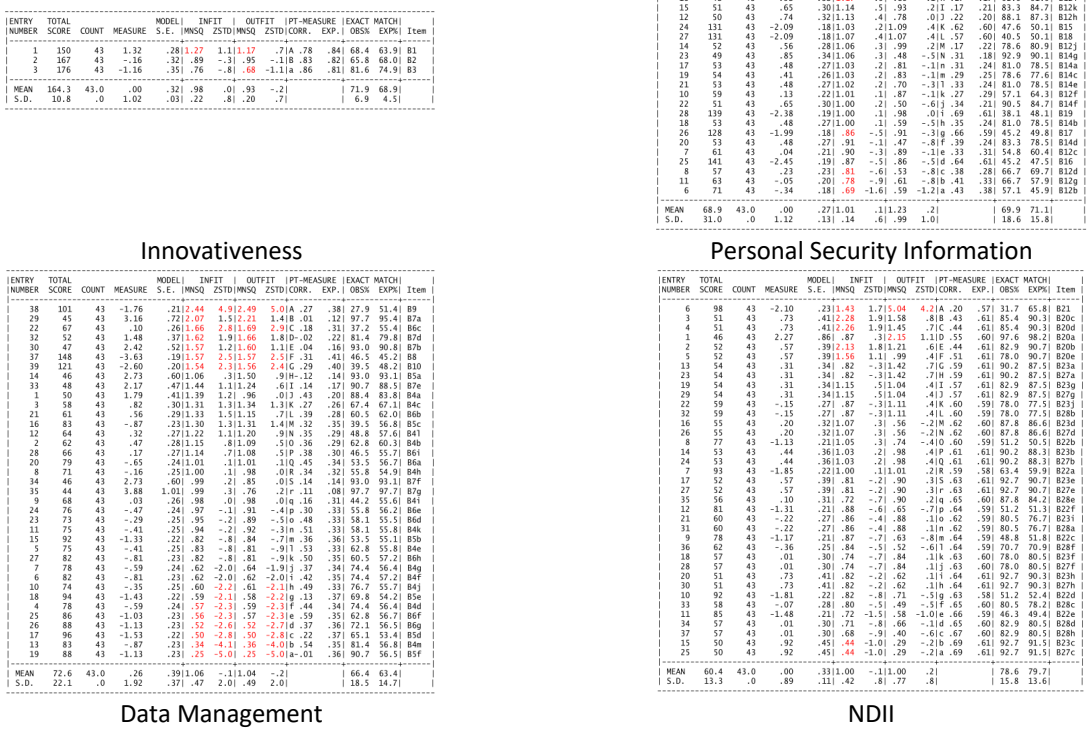
In the next section of the data management, the reliability value for both item and person is greater than 0.7, which is a high value and indicates high reliability. This result is confirmed by the accepted Cronbach's alpha value, which indicates that the data management items are very reliable and can accurately measure the relevant variables.

Meanwhile, both the items and the person in the personal security section have reliability values above 0.7, indicating high reliability. This is confirmed by the high Cronbach's alpha value, which highlights the reliability of the personal safety items and their ability to accurately measure the relevant variables.

Finally, in the awareness, perception and acceptance of the NDII section, both the items and the individuals have reliability values above 0.7, indicating high reliability. The substantial Cronbach's alpha value is further confirmation of the reliability of the items in this section and shows that they are reliable and can provide accurate measures of the relevant variables.

4.2.2.2 Mean Square (MNSQ)

The first step in assessing item fit is to measure the MNSQ of Infit/Outfit. Theoretical foundations state that the MNSQ represents the relationship or ratio between an observation and a person's expectations, with the ideal value being 1 [25]. In assessing the innovativeness item, a value outside expectations is indicated by infit and outfit values outside the range of 0.76 to 1.20 logit and 0.73 to 1.13 logit, respectively, as shown in Figure 2. Misfit is also indicated by z-std values exceeding the threshold t=+/-2logit. It should be noted, however, that no item met both criteria for classification as misfit, as indicated in the Figure 2.



Innovativeness | Personal Security Information | Data Management | NDII

Fig. 2. Item fit

For the data management section, items 13, 17, 19, 22, 26, 37, 38 and 39 were classified as misfits because their infit and outfit values were outside the respective ranges of 0.59 to 1.53 logit and 0.55 to 1.53 logit. However, since these items are part of larger item components and the reliability test results were good, they can be retained in the instrument.

Next, the MNSQ for personal security information section was unexpectedly high, as both the infit and outfit scores were outside the expected ranges of 0.87 to 1.15 logit and 0.24 to 2.22 logit, respectively. Nevertheless, the figure above showed that no item was classified as a misfit.

Finally, in the awareness, perception and acceptance of NDI services section, the MNSQ for the item was unexpectedly high as both the Infit and Outfit values were outside the predicted ranges of 0.58 to 1.42 logit and 0.23 to 1.77 logit respectively. The data figure showed that there were no items that fell into the misfit category.

In summary, some items were misfits, but none met both criteria for classification. For data management, some items were misfits but can be retained due to the good reliability tests. In the sections on personal security information and awareness, perception and acceptance of NDI services, no items were misfits, although some MNSQ values exceeded the expected range.

4.2.2.3 PCA

The analysis performed is based on PCA, a widely used statistical technique for reducing the dimensionality of a data set. When defining instruments that only measure in one direction, it is important that they are unidimensional. This helps to achieve accurate results and avoid ambiguous measurements. In the section on innovativeness, the data show that the raw variance explained by the measures reached a rate of 60.6%, which is comparable to the Rasch model rate of 60.7%. Although there was a slight difference caused by the interference of the items as noise, the measured noise level was only 26% above the control limit. Importantly, no item had a standardised residual correlation value greater than 0.7, indicating a good level of one-dimensionality.

Similarly, the data management section found that the percentage of raw variance explained by the measures was 46.6%, which is comparable to the 46% obtained using the Rasch model. Although the percentage was above the required minimum, there was 6.9% noise, which is below the acceptable range. However, no single variable had a standardised residual correlation value greater than 0.7, indicating a good level of one-dimensionality.

In the personal security information section, the data showed that the percentage of raw variance explained by the measures was 60.6%, comparable to the Rasch model percentage of 53.7%. The percentage was above the required minimum and the measured noise was 7.8% points below the acceptable threshold. Nevertheless, the standardised residual correlation value was greater than 0.7 for 12 items, indicating a possible respondent bias towards similar item pairs.

Finally, for the awareness, perception and acceptance of the NDII section found that the percentage of raw variance explained by the measures was 52.2%, which is consistent with the percentage of 49.6% obtained using the Rasch model. The percentage was higher than the minimum required by most standards. The value of the measured noise was 7.9 percentage points below the acceptable range. However, for 20 items, the value of the standardised residual correlation was greater than 0.7, indicating possible respondent confusion about similar item pairs.

Overall, the raw variance explained by the measures was comparable to the Rasch model, with some differences caused by the interference of noise. Although the noise level was slightly above the control level in some sections, no item had a standardised residual correlation value greater than 0.7, indicating a good level of one-dimensionality. Figure 3 shows the principal component analysis.

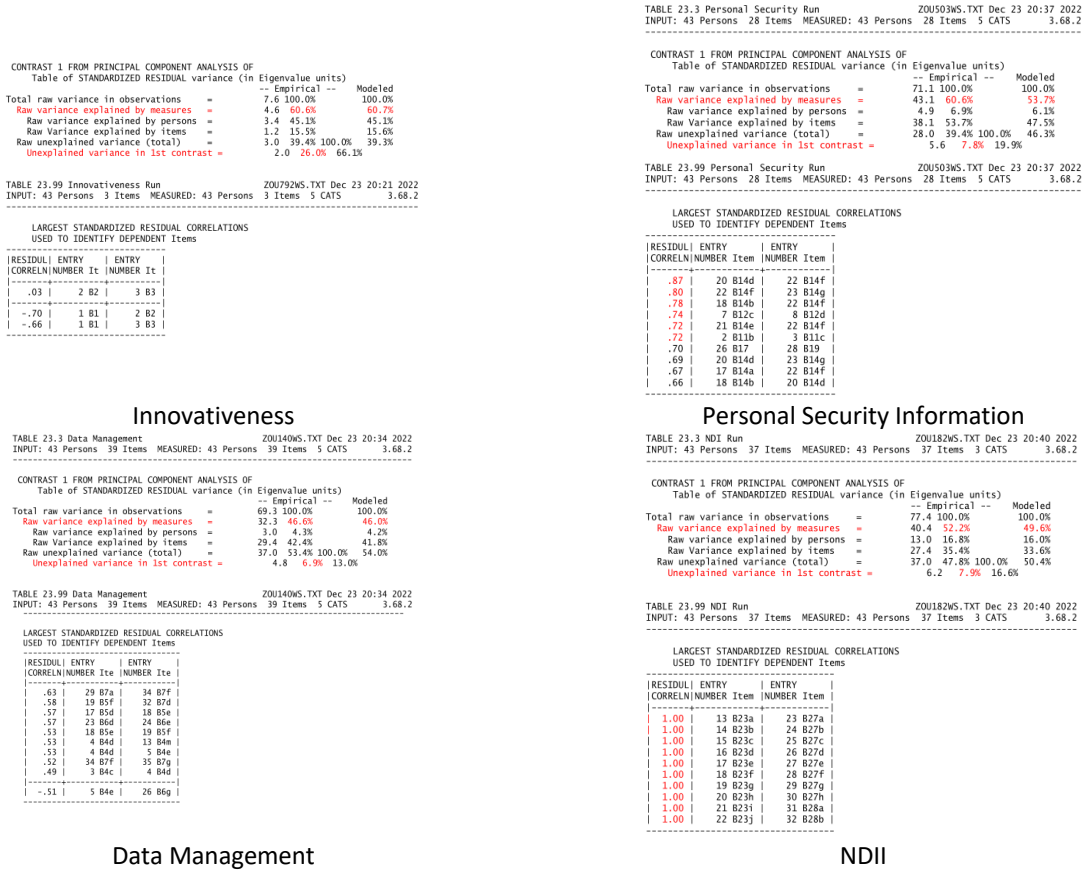


Fig. 3. Principal component analysis

5. Conclusion

The aim of this pilot study was to determine the public awareness, perception and acceptance of NDII in Malaysia. Using a mixed methods approach, we developed a self-administered questionnaire based on an extensive literature review, expert validation and a rigorous Rasch measurement analysis to assess the characteristics of the questionnaire items. Our results show that public awareness is limited, but perception and acceptance of NDII is higher. In particular, privacy and security concerns emerged as major barriers to uptake. Recommendations for improvement include increasing public awareness, improving perceived benefits and addressing privacy concerns. These findings provide critical insights into NDII awareness, perception and adoption, which are essential for successful implementation. The use of Rasch measurement analysis strengthens the credibility of the study and meets the needs of policy and practise. In addition, our work adds to the literature on DII uptake, particularly in the context of Malaysia. Future efforts could aim to debunk privacy and security concerns to increase the uptake of NDII. Further research into the benefits of the initiative, particularly in terms of efficiency, convenience and fraud prevention [26], remains important. Demographic factors such as age, gender and education should be explored for their impact on public adoption. As the NDII underpins Malaysia's digital transformation, it is worthwhile to examine the overall effectiveness of this transformation in achieving its goals.

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