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Purushottam Sahu

Indira Gandhi Krishi
 Vishwavidyalaya, Raipur,
 Chhattisgarh, India

Dipti

Indira Gandhi Krishi
 Vishwavidyalaya, Raipur,
 Chhattisgarh, India

DP Singh

Indira Gandhi Krishi
 Vishwavidyalaya, Raipur,
 Chhattisgarh, India

RR Saxena

Indira Gandhi Krishi
 Vishwavidyalaya, Raipur,
 Chhattisgarh, India

Assessment of reliability using Cronbach's α in survey research

Purushottam Sahu¹, Dipti², DP Singh³, RR Saxena⁴

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ABSTRACT

Abstract: A survey-based study was conducted regarding the issues faced by the government in implementing policies related to ICT in Raipur district. In this study, a total of 09 constraints related to ICT were selected i.e. Resource related issue, Level of computer illiteracy, Limited citizens awareness, Challenges of language, Resistance to change, Lack of trained person, storage of equipments, Level of difficulty, Gender. This survey was conducted in 2023-24, during which we surveyed four blocks in Raipur district. The Alpha method was used to test the reliability of the survey data.

Keywords: Information Communication Technology (ICT), Agriculture, Rural Development, Cronbach's Alpha

Introduction

Survey research is one of the most widely used methods for collecting data in social sciences, management, education, agriculture, and health sciences. Researchers frequently use questionnaires and rating scales to gather information about attitudes, perceptions, opinions, and behaviours of respondents. The accuracy and usefulness of research findings depend largely on the quality of the measurement instrument employed. Therefore, it is essential to ensure that survey instruments are capable of producing consistent and dependable results before they are used for data analysis and decision-making (Sekaran & Bougie, 2019) [5]. One of the most frequently reported measures of reliability in survey research is Cronbach's α (α). Originally developed within the framework of classical test theory, Cronbach's α is commonly used to examine the internal consistency of a set of questionnaire items. In practical survey research, it is often calculated for Likert-type scales to determine the degree to which items are related to one another and can reasonably be considered part of the same scale (Streiner, 2003; Gliem *et al.*, 2003) [6, 10]. Because of its simplicity and availability in widely used statistical software, Cronbach's α has become a standard statistic in empirical research.

Reliability is a fundamental characteristic of a good measurement instrument. It refers to the degree to which a scale or questionnaire yields consistent results when administered under similar conditions. An instrument with high reliability minimizes random measurement errors and enhances the credibility of the collected data. In survey research, where multiple items are often used to measure a single construct, assessing reliability becomes crucial for ensuring that all items contribute meaningfully to the measurement process (Nunnally & Bernstein, 1994) [4].

Among the various methods available for assessing reliability, Cronbach's Alpha is the most commonly used statistic for evaluating internal consistency. Introduced by Cronbach (1951) [1], this coefficient measures the extent to which the items within a scale are correlated and collectively represent the same underlying construct. The value of Cronbach's Alpha ranges from 0 to 1, with higher values indicating greater internal consistency among scale items. Due to its simplicity and effectiveness, it has become a standard reliability measure in survey-based studies across different academic disciplines (Cronbach, 1951) [1].

The assessment of reliability using Cronbach's Alpha plays a significant role in questionnaire development and validation. Researchers use this technique to identify items that may weaken the consistency of a scale and to refine instruments for improved measurement accuracy. Reliability analysis not only strengthens the quality of research instruments but also contributes to the validity of subsequent statistical analyses and interpretations. A well-designed and reliable instrument increases confidence in research findings and supports evidence-based conclusions (DeVellis, 2017) [2].

The present study focuses on the assessment of reliability using Cronbach's Alpha in survey research. The objective is to examine the importance of internal consistency analysis and to evaluate the reliability of survey instruments used for data collection. By understanding and applying Cronbach's Alpha, researchers can improve the quality of measurement scales and ensure that their findings are based on reliable and consistent data. Consequently, reliability assessment serves as a critical step in enhancing the scientific rigor and credibility of survey research (Hair *et al.*, 2019) [3].

Corresponding Author:

Purushottam Sahu

Indira Gandhi Krishi
 Vishwavidyalaya, Raipur,
 Chhattisgarh, India

Another important issue concerns the assumptions underlying Cronbach's α . Traditional applications of α are associated with assumptions such as essential tau-equivalence, which implies particular relationships among the true-score components of the items. When these assumptions are violated, α may not provide an accurate estimate of the reliability of a scale. Raykov (1997) [9] demonstrated that violations of essential tau-equivalence can affect the interpretation of coefficient α , highlighting the need for researchers to understand the statistical conditions under which the coefficient is being applied.

The widespread use of arbitrary cut-off values has also contributed to the misunderstanding of Cronbach's α . Researchers frequently classify scales according to fixed criteria, such as considering an α value of .70 or above to indicate acceptable reliability. However, such universal standards should not be applied mechanically to every research context. Lance, Butts, and Michels (2006) [13] examined the origins of commonly reported cut-off criteria and demonstrated that their widespread use does not necessarily provide a sufficient theoretical justification for treating a particular value as universally acceptable. The appropriate interpretation of reliability may depend on the purpose of the scale, the stage of research, the characteristics of the sample, and the consequences associated with measurement error.

The limitations of Cronbach's α have been extensively discussed in psychometric literature. Sijtsma (2009) [8] argued that researchers often place excessive emphasis on α despite its limited ability to address broader questions of measurement quality. Similarly, Streiner (2003) [6] emphasized that coefficient α should be interpreted carefully rather than treated as an automatic indicator of a good measurement instrument. These discussions suggest that reliability assessment should move beyond reporting a single coefficient and should consider the theoretical structure and intended purpose of the scale.

Psychometric theory provides a broader framework for understanding these issues. Raykov and Marcoulides (2011) [14] explain that reliability concerns the consistency and precision of measurement and can be approached through different models and estimators. Thus, Cronbach's α should not be viewed as the only possible method for evaluating the reliability of a multi-item instrument. Rather, its appropriateness should be considered in relation to the characteristics of the data, the measurement model, and the assumptions underlying the scale.

However, interpreting Cronbach's α is more complicated than simply determining whether its value exceeds a particular numerical threshold. A high α value does not necessarily demonstrate that a scale is unidimensional or that it provides a valid measurement of the intended construct. Internal consistency and validity represent different aspects of measurement quality, and reliability should therefore be considered as one component of a broader assessment of a research instrument (Streiner, 2003) [6]. In addition, α is influenced by factors such as the number of items in a scale and the relationships among those items. Consequently, an increase in the number of items may produce a higher α even when the items do not necessarily represent a stronger or more meaningful measurement of the construct (Cortina, 1993; Peterson, 1994) [11, 12].

Material and methods

Reliability test

The instrument validation processes that have been used in this study include content validity, construct validity and reliability. In order to have a reliable survey instrument and thus confidence in the research

findings, the researcher employed content validity (interviews) as a pre-data collection validity, and a construct validity and reliability for post-data collection validity. These validity techniques are recommended standards in IS research (Straub *et al.*, 2004). Cronbach's coefficient α value was assessed to examine the internal research consistency of measuring (Hinton *et al.*, 2004; Field, 2005; Straub *et al.*, 2004). Hinton *et al.*, (2004) suggest four points of reliability, excellent (0.90 and above), high (0.70 - 0.90), high moderate (0.50 - 0.70), and low (0.50 and below).

Let,

S_i^2 = Sample variance of questions i

S_{test}^2 = Sample variance of test total

Then,

$$\alpha = \left[1 - \frac{\sum_{i=1}^K si^2}{S_{test}^2} \right] \left(\frac{k}{k-1} \right)$$

The larger S_{test}^2 , the smaller the ratio $\frac{\sum_{i=1}^K si^2}{S_{test}^2}$ which is then subtracted from 1 large α .

Results and discussion

Reliability of ICT based survey data for Agriculture Department

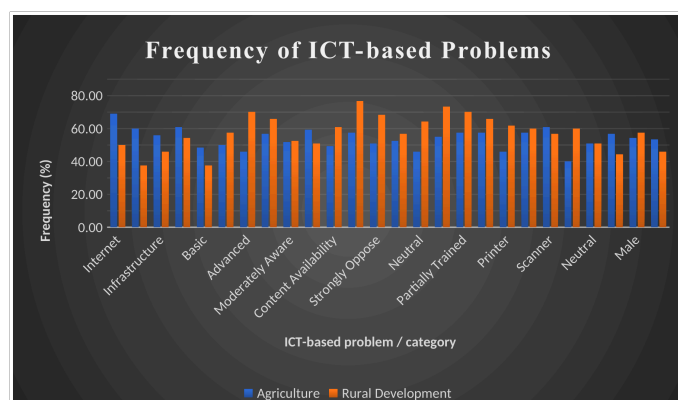
Cronbach's score for the reliability of measurements for different ICT based schemes and their problems ranged between 0.858 to 0.956 percent presented in Table 4.2. It lies between (0.943) for the resource related issues for ICT on e-government and (0.932) for the level of computer illiteracy, limited citizens awareness a reliability of (0.880) and challenges of language possessed a reliability of (0.842) for resistance to change a reliability of (0.868) and (0.875) for lack of trained person and (0.880) for shortage of equipment. The remaining constraint, namely level of difficulty on implementing technology had a Cronbach's score of (0.877) and for gender had score of (0.880). The findings showed that all the α values indicate the agriculture department is reliable and the higher the Cronbach's (α) value of schemes the higher the reliability is of measuring the same schemes (Dwivedi *et al.*, 2006).

Reliability of ICT based survey data for Rural Development Department

Cronbach's score for the reliability of measurements for different ICT based schemes and their problems ranged between 0.821 to 0.937 percent presented in Table 2. It lies between (0.931) for the resource related issues for ICT on e-government and (0.925) for the level of computer illiteracy, limited citizens awareness a reliability of (0.956) and challenges of language possessed a reliability of (0.881) for resistance to change a reliability of (0.897) and (0.857) for lack of trained person and (0.821) for shortage of equipment. The remaining constraint, namely level of difficulty on implementing technology had a Cronbach's score of (0.851) and for gender had score of (0.937). The findings showed that all the α values indicate the rural development department is reliable and the higher the Cronbach's (α) value of schemes the higher the reliability is of measuring the same schemes (Dwivedi *et al.*, 2006).

Table 1. Frequency of ICT based problem

ICT based Problems		Schemes of Government Sectors	
		Agriculture	Rural Development
Resource Related Issue	Internet	69.00	50.00
	Electricity	60.00	37.50
	Infrastructure	55.83	45.83
	Supplementary Resources	60.83	54.17
Computer Illiteracy	Basic	48.33	37.50
	Intermediate	50.00	57.50
	Advanced	45.83	70.00
Limited citizens' Awareness	Slightly Aware	56.67	65.83
	Moderately Aware	51.67	52.50
	Extremely Aware	59.17	50.83
Challenges of Language in Rural Influence	Content Availability	49.17	60.83
	Language Proficiency	57.50	76.67
Resistance to Change	Strongly Oppose	50.80	68.33
	Somewhat Oppose	52.50	56.67
	Neutral	45.83	64.17
Lack of Trained Persons	Untrained	55.00	73.33
	Partially Trained	57.50	70.00
	Trained	57.50	65.83
Shortage of Equipment's	Printer	45.83	61.67
	Projector	57.50	60.00
	Scanner	60.83	56.67
Level of Difficulty	Difficult	40.00	60.00
	Neutral	50.83	50.83
	Easy	56.67	44.17
Gender	Male	54.17	57.50
	Female	53.33	45.83

**Figure 1.** Frequency of ICT based problem**Table 2.** Reliability of Measurements for Different ICT based schemes and their problems

Constraints	Sample Size	Cronbach's Alpha(α) of Schemes	
		AG	RD
Resource Related Issues	120	0.931**	0.936**
Level of Computer Illiteracy	120	0.925**	0.954**
Limited Citizens Awareness	120	0.956**	0.917**
Challenges of language	120	0.881*	0.864*
Resistance to Change	120	0.897*	0.922**
Lack of Trained Person	120	0.858*	0.897*
Shortage of Equipment	120	0.943**	0.903**
Level of Difficulty on implementing Technology	120	0.930**	0.916**
Gender	120	0.925**	0.927**

Note: ** High Reliable, * Reliable, AG-Agriculture, RD-Rural Development

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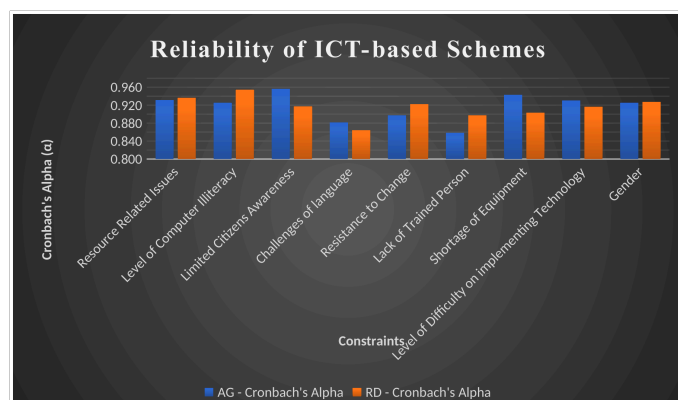


Figure 2. Reliability of Measurements for Different ICT based schemes and their problems

Conclusions

In this research, awareness, infrastructure, trained personnel, advancement, supplementary resources, internet, content availability, strong opposition, and electricity have been identified as key constructs by the government for the effective implementation of any policy in Agriculture department. The main ICT-based constraints advanced personnel, extremely aware, strong opposition, internet, infrastructure, content availability, trained, slightly aware, language proficiency, and electricity explain a comparatively large amount of variance, while other factors explain only a small amount of variance in implementing policies for rural development. Based on this, we can conclude that these key factors can play a significant role for the government in effectively implementing any ICT-based scheme.

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