P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 8; SP-Issue 1; January 2025; Page No. 102-107

Received: 08-11-2024
Accepted: 13-12-2024

Indexed Journal
Peer Reviewed Journal

A scale to measure Knowledge level of dairy farmers affected by Kerala flood 2018 on disaster

[1]L Arun and [2]R Senthilkumar

[1]Department of Veterinary and Animal Husbandry Extension Education, Veterinary College and Research Institute, Udumalpet, TANUVAS, Tamil Nadu, India

[2]Academic Staff College, Mannuthy, KVASU, Kerala, India

DOI: https://doi.org/10.33545/26180723.2025.v8.i1Sb.1578

Corresponding Author: L Arun

Abstract

The current study was envisioned to develop and standardize a scale for gauging dairy farmers' knowledge of the disaster. Based on the rationale and differentiation of well-knowledgeable dairy farmers from ill-informed dairy farmers, 54 items widely covering each facet of disaster were constructed. After carrying out the relevancy test with the inputs from the extension experts, 22 items were prudently chosen. The attained scores from each 22 items were used for item analysis encompassing item difficulty index, discrimination index and point biserial co-relation. The knowledge items with a difficulty index ranging from 0.25 to 0.75, discrimination index above the score of 0.2 and point biserial correlation value at - 5% significance were selected for the knowledge scale. A total of 12 knowledge items were selected for the construction of the final scale. Cronbach alpha was used for the measurement of the reliability. Cronbach's alpha score was excellent at 0.824, which is very high and specifies strong internal consistency amongst the 12 selected knowledge items. The established knowledge test was found to be a very constant and trustworthy measurement.

Keywords: Dairy farmers, knowledge, difficulty and discrimination index, reliability

1. Introduction

Knowledge is the highly appreciated form in which one is in cognitive interaction with the reality. (Zagzebski,2017) [32]. FAO defines disaster as a major disturbance of the functioning of a community or a society resulting from hazardous events interacting with conditions of exposure, susceptibility, and capability, therefore producing one or more of the following: human, economic, material, and environmental impacts and loss (Anonymous, 2017) [4] With 27 states and 7 union territories vulnerable to recurring natural hazards, India is among the most disaster-prone nations in the world and more recently the disasters have become higher in magnitude and frequencies (Patel *et al.*, 2019[24]; Chakraborty and Joshi, 2016[11]). India is one of the most disaster-prone countries due to its vast geographical area and complex geological, meteorological, and demographic features. (Mishra *et al.*, 2016) [21].

Kumar and Dimiri (2018) [16] deduced that in India over 40 million hectares (12%) are prone to floods and the perusal of Anonymous, (2018c) [7] report revealed that from 1953 to 2016 India lost 1,05,472 human lives and 60,22,676 cattle to flood disaster. Lal *et al.* (2015) [19] remarked that livestock is most vulnerable to flood which leads to permanent loss to the farmers and the rescue, relief and rehabilitation are not directed toward farm animals and their woes (Pyne *et al*., 2009) [25].

Floods in India are triggered by excessive precipitation, which has spiked in recent decades and is projected to increase even more as the climate gets warmer. (Ali *et al.*, 2019; Mukherjee *et al.*, 2017) [1, 22]. According to Lal *et al.* (2018) [18] due to climate change several areas of peninsular India, especially the Western Ghats, are anticipated to experience an increase in total precipitation accompanied with higher temporal variability.

Kerala witnessed an unprecedented amount of rainfall and flooding in August 2018. (Viswanadhapalli *et al*., 2019) [31]. From 1 June 2018 to 19 August 2018 a total of 2346.6 mm of rain poured in Kerala according to IMD (Anonymous, 2018d) [8], which was about 164% above the normal (*Sudheer et al.*, 2019) [28]. The devastating floods affected 54 lakh people (Mishra and Nagaraju, 2019) [20], took 445 lives (Vishnu *et al.*, 2019) [30] and the estimated loss was over ₹ 15,800 crores (Kondapalli *et al.*, 2019) [15]. A total of 7,765 small animals, 40,188 large animals and 7,99,256 birds died due to flood catastrophe (Anonymous, 2018a) [5].

The United Nations in its Post-disaster Needs Assessment (PDNA) Floods and Landslides – August 2018 in Kerala state revealed that though flooding advice warnings were provided to the public, there was a common unwillingness to respond to the flood warnings due to a lack of knowledge about the effect of the flooding (Anonymous, 2018b) [6]. The Sendai Framework for Disaster Risk Reduction (SFDRR) 2015–2030 emphasizes that calamity risk reduction strategies require knowledge to facilitate informed decision-making and coordinated action. (Anonymous, 2015a) [2]. SFDRR also flagged its concerns that many countries do not methodically gather disaster-related evidence, data, and information for spreading knowledge on the disaster. (Anonymous, 2015b). [3]

According to Biswas and Saha (2020) [10] agriculture growth requires the study and application of knowledge in terms of information generation, diffusion, transformation, execution, and retention. In these circumstances, it is vital to educate farmers on how to effectively deal with floods and other disasters. There is no appropriate scale accessible to measure the dairy farmers' knowledge of disaster. Thus, the current study was designed to develop and standardize a scale for measuring dairy farmers' knowledge of the disaster. For this study, knowledge was operationalised as the dairy farmer's information and understanding of the disaster.

2. Materials and Methods

The current study has been carried out in two panchayats, Kozhinjampara and Perumatty, in Palakkad district, Kerala, in December 2021. A total of 60 respondents were chosen, comprising 30 respondents drawn from every panchayat. The following procedures were employed to develop the knowledge scale.

2.1 Item collection

Fifty-four knowledge questions (items) meant to measure the knowledge level of flood-affected dairy farmers on disaster were collected after textbook reference, literature study, and discussions among field extension staff and subject matter specialists.

2.2 Relevancy rating

Not all of the statements collected are probably equally significant in assessing flood-affected dairy farmers' knowledge about the disaster. Hence, a qualified panel of judges analysed these statements to determine their relevance for inclusion in the final scale. The whole 54-statement list was submitted to an ensemble of experts who are professionals in the discipline of extension education. The statements were sent to 45 judges, who were requested to critically evaluate each statement for its significance in evaluating the dairy farmers' level of knowledge on disaster. The judges were prompted to respond on a four-point scale, ranging from most relevant, relevant, somewhat relevant and not relevant with scores being 4, 3, 2, and 1. The relevance score for each item was calculated by summing the rating scale scores from all of the judges' responses. A trio of tests were performed on the data, such as relevancy percentage, relevancy weightage, and mean relevancy scores for all statements.

The statements matching the following measures, i.e., relevance percentage >70, relevance weightage >0.70, and mean relevancy score > 2.8, were selected.

From the total of 54 knowledge question(items) 22 were selected

2.3 Item analysis

Item analysis is an essential phase in developing a valid and reliable scale. The goal of item analysis is to establish how well each item differentiates between respondents with high and low knowledge. (Saravanan *et al.*, 2009) [27] and to identify the items that result in an internally consistent scale and eliminate those that do not represent the universe of investigation. (Sahoo *et al.*, 2019) [26].The item analysis demonstrates how well each particular item correlates with the other items in the study.

The items obtained for the development of the knowledge test were in objective form. The questions were yes or no, with impartial and objective assessment. The 22 questions chosen were administered to sixty dairy farmers. Responses were scored. One mark was assigned for each right answer. Each incorrect response, as well as those that the respondents did not know, received a 0 score. The respondents' overall knowledge score was computed by adding the results of all the questions. The Difficulty Index, Discrimination Index, and Point biserial correlation were all determined using the calculated knowledge scores.

2.4 Difficulty index (DI)

The difficulty index shows the degree to which an item is difficult. An item should not be too simple that any individual can answer it, nor should it be too tough that none of them could answer. (Nagam and Husain 2016) [23]. The difficulty index (p-value), often known as the easy index, represents the percentage of respondents who had answered correctly. It varies from 0 to 100 per cent. The greater the percentage, the simpler the item is. The accepted difficulty range is 25-75%. Items with p-values less than 25% and greater than 75% are deemed tough and simple, correspondingly. The complexity of a question varies depending on the individual. A simple metric of difficulty is the percentage of responders who properly answer an item. The difficulty index of each of the 22 items was computed by dividing the total correct replies for a specific item by the total number of respondents as shown below.

$$Pi = \frac{ni}{Ni} x100$$

Where,

Pi	=	difficulty index in the percentage of the i^{th} item
ni	=	number of respondents giving the correct answer to i^{th} item
Ni	=	total number of respondents to whom the items were administered i.e. 60

2.5 Discrimination index (DcI)

The discrimination index determines whether an item discriminates between a well-informed and a poorly informed respondent. (Bhatt and Patel, 2010) [9]. The statement to which everyone correctly responded or that no one in the sample responded had no discriminatory value. As a result, only statements having a strong ability to discriminate all respondents of varying levels of knowledge were included in the final list. The discriminating capability of all seventeen items was calculated using the E1/3 method to determine item discrimination, as detailed below. In this procedure, 60 respondents were split into six equal groups of ten each, and they were arranged in descending order of the magnitude of their knowledge scores. The middle two groups were eliminated. The middle two groups were eliminated. Only four extreme groups, i.e. those with the highest and lowest scores, were used when calculating the 'Discrimination Index'. It's calculated using the following formula:

$$E1/3 = \frac{(S1+S2)-(S5+S6)}{N/3}$$

Where,
N = Total number of respondents to whom the items were administered.
S1 and S2 are the frequencies of correct answers of the highest and higher scores, respectively
S5 and S6 are the frequencies of correct answers of lower and lowest scores, respectively

2.6 Point biserial correlation (Rp bis)

A correlation between a continuous and a dichotomous variable is known as the point-biserial correlation. (Demirtas and Hedeker, 2016) [12]. The primary objective of calculating point biserial correlation (Rp bis) was to assess the items' internal consistency, or the relationship between the total score and a dichotomized answer to any particular item. It refers to the relationship between respondents' correct and incorrect scores on a specific set of items. It is a unique type of correlation between a dichotomous variable (the multiple-choice item score that is right or wrong, 0 or 1) and a continuous variable. (Sureshverma *et al*., 2018) [29]. Point biserial correlation was utilized for evaluating an item's internal consistency, as well as its relationship with the total score when it became apparent to be a dichotomised answer to a particular item.

$$Rp\ bis = \frac{Mp-Mq}{Sigma} X\sqrt{pq}$$

where,
Rp bis is the point biserial correlation,
Mp is the mean of the total score of the respondents who answered an item correctly
Mq is the mean of the total score of the respondents who answered an item incorrectly, sigma is the standard deviation of the entire sample,
p is the proportion of the respondents giving the correct answer to an item
q is the proportion of the respondents giving the incorrect answer to an item.
The resulting point biserial correlation values were statistically tested with n-2 degrees of freedom.

3. Results and Discussion

The knowledge items were obtained from multiple sources and administered to 60 respondents. Scores were assigned as one for a valid response and zero for an erroneous one. After receiving responses from all 22 items, the difficulty index, discrimination index, and point bi-serial correlation were computed using the formula described in the methodology. (Table 1). Those knowledge items scoring difficulty index values within 0.25 to 0.75, a discrimination index value above 0.2, and a point bi serial correlation value, which was significant at a 5 % level of significance, were selected as final items of the knowledge test.

Finally, 12 items (Table 2) were chosen for the knowledge test, which was deemed as neither too tough nor too simple to answer and could distinguish well-informed persons from those who were less informed.

Table 1: Calculation for selection of suitable knowledge items for disaster

Sl. No.	Frequencies of correct answer of respondents in four extreme groups				Total frequencies of correct answers by all six groups	Difficulty index	Discrimination index	Rp bis value
	S-1	S-2	S-5	S-6		(P)	(E 1/3)	
1	10	7	9	9	51	85.00	-0.05	-0.043
2#	8	8	6	4	41	68.33	0.3	0.322*
3#	9	5	5	2	35	58.33	0.35	0.343**
4	7	2	4	4	27	45.00	0.05	0.065
5#	7	8	4	1	27	45.00	0.5	0.404**
6	5	6	6	3	26	43.33	0.1	0.094
7#	7	9	6	5	36	60.00	0.25	0.129
8#	9	8	3	2	31	51.67	0.6	0.582**
9#	9	9	3	1	29	48.33	0.7	0.683**
10	8	6	3	0	36	60.00	0.05	0.04
11#	9	8	3	1	27	45.00	0.65	0.649**
12#	9	8	7	3	41	68.33	0.35	0.392**
13#	9	7	3	1	26	43.33	0.6	0.610**
14	4	4	2	1	14	23.33	0.25	0.365**
15#	9	1	0	1	15	25.00	0.45	0.434**
16	8	2	1	1	13	21.67	0.4	0.460**
17	7	6	2	6	34	56.67	0.25	0.226
18#	6	7	2	2	29	48.33	0.45	0.310*
19	6	6	4	2	32	53.33	0.3	0.248
20#	9	3	0	1	21	35.00	0.55	0.468**
21	1	4	2	0	11	18.33	0.15	0.121
22#	9	8	8	2	43	71.67	0.35	0.317*

- Items selected for final inclusion
* Significant at 5% level
** Significant at 1% level

Table 2: Items identified for testing knowledge on disaster

Sl. No	Selected questions	Knowledge items for disaster (included in the interview schedule)
1	2	Natural Disasters are Earthquake / Flood / Cloud-burst / Lightening / Tsunami / Cyclone. (Name any one)
2	3	Man-made Disasters are Urban fire / Chemical leak / Accident (rail/road/air/boat) / Riots / Stampede / Hijack. (Name any one)
3	5	Learning basic survival skills like swimming will save the lives of people during disaster
4	7	The most common disaster affecting Kerala is flood associated with heavy rainfall
5	8	The major cause for flood disaster is reclamation and resettlement of flood plains
6	9	Lack of separate storm water and sewerage water drain, lead to Urban flooding
7	11	The magnitude of Earthquake is denoted by Richter Scale
8	12	Earthquakes causes landslides
9	13	Landslides are caused by torrential rains
10	15	Earthquake with 6.5 Richter scale normally causes tsunami
11	18	Tsunami is commonly associated with Coastal regions
12	20	Earthquake in Ocean leads to Tsunami
13	22	India witnessed Tsunami in the year 2005

3.1 Standardisation of the scale

3.1.1 Validity of the knowledge test

Validity refers to the extent to which theory and evidence justify test score interpretations for planned uses of tests. (Kane, 2016) [14]. The validity of the knowledge evaluation was determined through content validity. The content validity of the knowledge test was guaranteed by selecting items in conjunction with experts. All conceivable care was taken while choosing the items and were subjected to difficulty and discrimination index and point biserial correlation, to select the final knowledge items. Hence, it was rational to accept that the test fulfilled the representative as well as the practical approach of test construction, the criteria for content validity.

3.1.2 Reliability of the knowledge test

A test is considered to be reliable when it produces the same result consistently. (Kumar *et al.* 2016) [17] The reliability of the constructed knowledge test was determined by the Cronbach alpha coefficient of the reliability test. It is extensively used as an index of reliability and is frequently described in social and behavioural studies (Zumbo and Rupp, 2004) [33]. The reliability of the developed knowledge scale was determined by Cronbach's alpha. The developed knowledge test on the disaster was administered to 40 randomly selected flood-affected dairy farmers from two village panchayats in Palakkad District, Kerala: Kozhinjampara and Permatty in December 2021. The alpha was calculated using the formula as follows

$$\alpha = \frac{K}{K-1}\left(\frac{\sum_{i}^{K}{=1}\ \sigma^2 y_i}{\sigma^2 x}\right)$$

Where,

α = Cronbach's alpha reliability coefficient,

K = Number of items,

$\sigma^2 y_i$ = the variance of item i for the current sample of persons,

$\sigma^2 x$ = the variance of the observed total test scores.

Cronbach's alpha value turned out to be exceptional.824 is very high, indicating great internal consistency among the 12 knowledge items.

Essentially, this means that respondents who recorded high for one knowledge item also recorded high for the others; similarly, respondents who recorded low score for one item tended to record low scores for the other items. Thus, obtaining the score for one knowledge statement enables one to predict with some accuracy the probable scores for the other knowledge items.

Table 3 points out the column with the *'Corrected Item - Total Correlation'* for each item which represents the relationship between a certain knowledge item and the cumulative score of the remaining items. Table 3 additionally depicts the Cronbach's alpha that would result if a certain component was removed. It suggests the alpha value of the specified item was not included in a group of items. For example, deleting Item 1 would reduce Cronbach's alpha value from.824 to.823. It indicates that removing one item from the scale (Item 1) will reduce the alpha value, which contributes to the knowledge scale's overall dependability.

According to George and Mallery (2003) [13], Cronbach's alpha values of >.9 are considered outstanding, >.8 are good, >.7 are acceptable, >.6 are doubtful, >.5 are poor, and <.5 are unsatisfactory. While increasing the value of alpha is partially dictated by the number of items on the scale, it should be emphasized that this has decreasing returns. The alpha value of the developed knowledge scale was determined to be outstanding, indicating great internal consistency among the items.

Table 3: Item total Statistics

Item	Scale means if Item Deleted	Scale Variance if Item Deleted	Corrected Item - Total Correlation	Cronbach's Alpha if Item Deleted
Item 1	2.42	9.609	0.431	0.823
Item 2	2.36	9.274	0.367	0.821
Item 3	2.35	9.298	0.351	0.822
Item 4	2.36	9.700	0.223	0.832
Item 5	2.40	9.219	0.442	0.814
Item 6	2.34	8.359	0.682	0.793
Item 7	2.36	9.178	0.413	0.817
Item 8	2.36	8.800	0.558	0.805
Item 9	2.33	8.028	0.810	0.780
Item 10	2.37	8.774	0.584	0.802
Item 11	2.35	8.898	0.498	0.810
Item 12	2.41	9.140	0.497	0.810

4. Conclusion

The developed scale's validity and reliability demonstrated that the results were precise and consistent. The test which was developed could potentially be used to measure dairy farmers' knowledge of the disaster. Based on knowledge levels, effective disaster mitigation measures might be implemented. With appropriate modifications, this scale may be used to assess farmers' knowledge of disasters beyond the study area with suitable modifications

5. References

1. Ali H, Modi P, Mishra V. Increased flood risk in Indian sub-continent under the warming climate. Weather Clim Extremes. 2019;25:100212.
2. Anonymous. Sendai framework for disaster risk reduction 2015–2030. United Nations International Strategy for Disaster Reduction. Available from: https://www.wcdrr.org/preparatory/post2015. Accessed on 02 May 2021.
3. Anonymous. Global Assessment report on disaster risk reduction 2015: Making Development Sustainable: the Future of Disaster Risk Management. United Nations International Strategy for Disaster Reduction. Available from: https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2015. Accessed on 05 May 2021.
4. Anonymous. The impact of disasters and crises on agriculture and food security. Food and Agriculture Organization of the United Nations. Available from: https://www.fao.org/3/i8656en/i8656en.pdf. Accessed on 12 May 2021.
5. Anonymous. Additional memorandum. Kerala Floods – 2018. 1st August to 30th August 2018. Government of Kerala, Thiruvananthapuram. Available from: https://sdma.kerala.gov.in/wp-content/uploads/2019/08/Memorandum2-Floods-2018.pdf. Accessed on 07 May 2021.
6. Anonymous. Kerala post disaster needs assessment floods and landslides - August 2018. Government of Kerala, Thiruvananthapuram. Available from: https://reliefweb.int/report/india/kerala-post-disaster-needs-assessment-floods-and-landslides-august-2018. Accessed on 05 Apr 2021.
7. Anonymous. State wise flood damage statistics. Central Water Commission. Available from: https://cwc.gov.in/sites/default/files/statewiseflooddatadamagestatistics.pdf. Accessed on 02 Apr 2021.
8. Anonymous. Kerala floods of August. Central Water Commission. Available from: https://reliefweb.int/sites/reliefweb.int/files/resources/Rev-0.pdf. Accessed on 04 Apr 2012.
9. Bhatt PM, Patel HB. A scale to measure knowledge of dairy farmers regarding improved animal husbandry practices. Gujarat J Ext Educ. 2009;20-21:11-14.
10. Biswas M, Saha A. Mapping of agriculture knowledge information system for betel vine growers. Int J Econ Plants. 2020;7(4):190-192.
11. Chakraborty A, Joshi PK. Mapping disaster vulnerability in India using analytical hierarchy process. Geomatics Nat Hazards Risk. 2016;7(1):308-325.
12. Demirtas H, Hedeker D. Computing the point-biserial correlation under any underlying continuous distribution. Commun Stat Simul Comput. 2016;45(8):2744-2751.
13. George D, Mallery P. SPSS for Windows step by step: A simple guide and reference. 11.0 update. Boston: Allyn & Bacon; 2003. p. 231.
14. Kane MT. Validity as the evaluation of the claims based on test scores. Assess Educ Princ Policy Pract. 2016;23(2):309-311.
15. Kondapalli S, Nagamanickam RK, Ghosh S. Utilizing insights from 2018 Kerala floods damage survey in catastrophe flood modeling. In: Hydro 2019 International Conference, Hyderabad; c2019. p. 1-11.
16. Kumar G, Dimri BR. Armed forces and disaster management in India. Econ Aff. 2018;63(3):753-760.
17. Kumar R, Slathia PS, Peshin R, Gupta SK, Nain MS. A test to measure the knowledge of farmers about rapeseed mustard cultivation. Indian J Ext Educ. 2016;52(3&4):157-159.
18. Lal M, Sau BL, Patidar J, Patidar A. Climate Change and Groundwater: Impact, Adaptation and Sustainable. Int J Bio-Res Stress Manag. 2018;9(3):408-415.
19. Lal SP, Kadian KS, Jha SK, Sharma AK, Goyal J, Kumar RS, et al. Change in livestock holdings, adaptation strategies and livelihood security of the farmers affected by national calamity in Bihar, India. Indian J Dairy Sci. 2015;68(1):83-90.
20. Mishra AK, Nagaraju V. Space-based monitoring of severe flooding of a southern state in India during southwest monsoon season of 2018. Nat Hazards.

2019;97(2):949-953.
21. Mishra BP, Kumar K, Sujan DK, Singh RB. Socio-economic implications of managing disaster. Indian Res J Ext Educ. 2016;9(1):58-61.
22. Mukherjee S, Aadhar S, Stone D, Mishra V. Increase in extreme precipitation events under anthropogenic warming in India. Weather Clim Extremes. 2018;20:45-53.
23. Nagam KK, Husain AS. A standardized knowledge test to measure the extent of knowledge of agricultural extension personnel on m-tools. J Ext Educ. 2016;28(1):5614-5619.
24. Patel SK, Mathew B, Nanda A, Pati S, Nayak H. A review on extreme weather events and livelihood in Odisha, India. Mausam. 2019;70(3):551-560.
25. Pyne SK, Samanta G. Livestock management at different levels of disaster-strategy and execution. Indian J Anim Res. 2009;43(2):99-102.
26. Sahoo AK, Burman RR, Lenin V, Sajesh VK, Sharma PR, Sarkar S, Sharma JP, Iquebal A. Scale construction to measure the attitude of farmers towards IARI-Post Office linkage extension model. Asian J Agric Ext Econ Sociol. 2019;37(4):1-13.
27. Saravanan R, Veerabhatraiah V, Sivaliga Gowde NS. Scale to measure farmers' extension service commitment in public and private extension. Mysore J Agric Sci. 2009;43(2):322-326.
28. Sudheer KP, Bhallamudi SM, Narasimhan B, Thomas J, Bindhu VM, Vema V, Kurian C. Role of dams on the floods of August 2018 in Periyar River Basin, Kerala. Curr Sci. 2019;116(5):780-794.
DOI: 10.18520/cs/v116/i5/780-794
29. Sureshverma R, Samuel G, Rao IS, Sagar V. Construction of knowledge test to measure the knowledge on recommended groundnut production practices. J Ext Educ. 2018;30(3):6129-6136.
30. Vishnu CL, Sajinkumar KS, Oommen T, Coffman RA, Thrivikramji KP, Rani VR, Keerthy S. Satellite-based assessment of the August 2018 flood in parts of Kerala, India. Geomatics Nat Hazards Risk. 2019;10(1):758-767.
31. Viswanadhapalli Y, Srinivas CV, Basha G, Dasari HP, Langodan S, Venkat Ratnam M, Hoteit I. A diagnostic study of extreme precipitation over Kerala during August 2018. Atmos Sci Lett. 2019;20(12):e941.
32. Zagzebski L. What is knowledge? In: Greco J, Sosa E, editors. The Blackwell guide to epistemology. 1st ed. Blackwell Publishing Ltd; c2017. p. 92-116.
33. Zumbo BD, Rupp AA. Responsible modeling of measurement data for appropriate inferences: important advances in reliability and validity theory. In: David K, editor. The SAGE Handbook of Quantitative Methodology for the Social Sciences. Thousand Oaks, CA: Sage Press; c2004. p. 73-92.