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Construction of attitude scale to measure the attitude of farmers about digital technologies

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Abstract
Attitudes are evaluative statements or judgments about items, people, or events that are either positive or negative (Robbins, 1989). They express one's feelings regarding something. The current study was done in Haryana's Karnal, Rohtak, and Jhajjar districts, with 360 respondents, including male and female farmers. 30 items spanning a list of digital technologies were produced based on farmer attitudes rather than poorly informed ones. The S and Q values were calculated using the scores collected from each item. In the end, a total of ten items were chosen. The split half approach was used to assess the attitude scale's reliability. At a 1% level of significance, the coefficient of correlation value in the split half was 0.80. Developed attitude scale was found to be high stable and dependable measurement.

Keywords: Attitude, S, Q value, reliability, validity

Introduction
Agriculture is the principal occupation of the majority of Indians living in rural areas, contributing roughly 17-18% of the country's Gross Domestic Product (GDP) and employing more than half of the country's total workforce (India Economy Survey, 2018). With the integration of the agro-food chain and the global market, agriculture has altered tremendously over the last fifty years. For developing countries like India, where agriculture provides a majority of people' livelihoods in both the farm and non-farm sectors, agriculture's sustainability cannot be separated from the question of livelihoods (Acharya, 2006).
Digital technologies, on the other hand, are critical for small farmers to make the transition from input-intensive to knowledge-intensive agriculture (Glendenning et al., 2010) [3]. New technologies can be a powerful engine of growth, equity, and sustainability, but they are neither panaceas or replacements for human and institutional development. Although they have a broad scope, their geographical application is still limited in rural areas; many farmers remain unaware of such advancements. The distribution of technology is unequal. Farmers in rich areas like Punjab, Haryana, and Maharashtra have better access to public safety nets and technology than their poorer colleagues in impoverished states, who continue to use outdated practises and knowledge (Lele and Goswami, 2017) [4].
Agriculture, trade, research and development, education, training, and advice policies have had a significant impact on technology selection, agricultural production levels, and farm practises over many decades (Schwab, 2016) [8]. To make their farming more accurate, productive, and profitable, farmers use a variety of technology, channels, and analytic skills. Now-a-days, farming is becoming a more time-critical and information-intense business. Therefore, keeping the objective of the study in mind, for the present study, the psychological objects were the statements on different dimensions of various digital technologies with respondent's agreement or disagreement were recorded. The technique adopted to develop the attitude scale was a combination of Thurstone's method of equal appearing interval and Likert's method of summated ratings. The procedural steps followed in developing to standardize attitude scale to measure the farmer's attitude towards digital technologies are discussed in this paper.

Methodology
In the present study, attitude scale was constructed by following "Split-half method" scaling technique developed by Thurstone and Chave (1929) [12]. For the purpose, attitude was operationalized as the degree of positive or negative affect of the farmers regarding digital technologies. Possible statements concerning 'digital technologies for farmers" were collected based on the review of literature and discussion with scientists, assistant professors, professors and from extension personnel.

In total, 30 statements were prepared which were organized and structured in the form of attitude items. The items were screened by following the informal criteria suggested by Edwards (1969) [2]. Based on the screening, 10 items were selected which formed the universe of the content. The selected items includes both positive and negative statements. The 10 statements were then subjected to judges opinion on a five-point continuum ranging from strongly agree to strongly disagree. The items were screened by following the informal criteria suggested by Edwards (1969) [2] for editing the statements to be used in the construction of the attitude scale. The list of statements was sent to 70 judges who comprised of scientists, National Institute of Agricultural Extension Management (MANAGE), Hyderabad, College of Agriculture, Hisar, National Dairy Research Institute, Karnal, College of Agriculture, Pune, Sreemati Nathibai Damodar Thackersey Women's University, Mumbai, ICAR-ATARI-Agricultural Technology Application Research Institute, Karnataka. Among the 70 judges, 50 judges responded by sending their judgments. Based on the judgments the "S" and "Q" values for each statement were calculated by applying the equal appearing scale Interval formula as suggested by Thurstone and Chave (1929) [12].

The five points of the rating scale were assigned score ranging from 1 for Strongly Disagree to 5 for Strongly Agree. Based on the judgment, the median value of the distribution and the Q value for the concerned statement were calculated with the help of following formula.

$$S=l+(.50-\sum P_b)\div P_w\ i$$

Where S= The median or scale value of the statement
l= The lower limit of the interval in which the median fall
$\sum P_b$= The sum of the proportion below the intervals in which the median falls
P_w= The proportion within the interval in which the median fall.
i= The width of the interval and it is assumed to be equal to 1

The inter-quartile range (Q = Q3 – Q1) or (Q = C75 – C25) for each statement was worked out for determination of ambiguity involved in all the statements. Only those statements, whose median values were found greater than Q values were selected.

To determine value of Q, two points measured were, the 75th (Q3) centile and 25th (Q1) centile. The 25th centile value was obtained by the following formula.

$$C_{25}=l+(.25-\sum P_b)\div P_w$$

Where C_{25}= the 25th centile
l= lower limit of the interval in which the 25th centile falls
$\sum P_b$= the sum of the proportion below the interval in which the 25th centile falls
P_w= the proportion within the interval in which the 25th centile falls
i= the width of the interval and is assumed to be equal to 1
For the 75th centile will given by:

$$C_{75}=l+(.75-\sum P_b)\div P_w$$

Where C_{75}=the 75th centile
l= lower limit of the interval in which the 75th centile falls
$\sum P_b$= the sum of the proportion below the interval in which the 75th centile falls
P_w= the proportion within the interval in which the 75th centile falls
i= the width of the interval and is assumed to be equal to 1
Coefficient of reliability scores between these two sets of score were calculated by Rulon‟s Formula (Guilford 1954) as seen below, which was observed 0.802798 for digital technologies.

Where, rtt = Co-efficient of reliability
= Variance of those two differences
= Variance of total score

Results and Discussion

An objective methodology was devised in order to select the attitude items keeping in mind that the statements selected should adequately represent the respective domain of the universe of content with respect to 'Digital Technologies', split-half method, as far as possible items with high scale values and smaller Q values be selected and more or less equal number of items with agree and disagree attitudes be selected. The scale values were arranged in descending order of magnitude and finally 10 such items were arrived at. To select the attitude items, the scale values and the corresponding Q values were considered. Care was taken to ensure that the selected items represented the universe of content and covered the psychological and economical domains of agriculture. Thereby, 10 items were selected with split-half method and with a uniform distribution along the psychological continuum. The attitude scale thus constructed is given in the Table 1.

Reliability and validity of the scale

A scale is reliable when it produced the same results when applied to the same sample repeatedly. The split-half technique method of reliability was employed. This test was conducted on 30 respondents. The 10 statements scale was split into two equal halves by using Odd-Even method (Singh, 2015) [9]. The scores were subjected to product moment correlation test in order to find out the reliability of the half test. Each of the two sets of items was treated as two separate scales and then these two sub-scales were correlated. Coefficient of reliability scores between these two sets of score were calculated by Rulon‟s Formula (Guilford 1954) which was observed 0.802798 for digital technologies. Reliability is directly related with the length of the scale when we split the scale on odd and even number items. The reliability coefficient which has been calculated is the value of half size of the original scale. Thus, scorrection factor is calculated by using Spearman Brown formula for all the three parts of scale individually using following formula. The coefficient of reliability was calculated by the Spearman Brown formula which came to be 0.89061 for digital technologies. Thus, the scales developed were found highly reliable. According to Singh (2015) [9]; Kumar *et al.* (2015); Kumar *et al.* (2016) when the purpose of the test is to compare the means of the two groups of narrow range, a reliability coefficient of 0.50 or 0.60 would suffice. Hence, the constructed scale is reliable as the r tt was > 0.60.

Validity of a scale is the property that ensures that the obtained scores measure the variable they are supposed to measure (English and English, 1961). The statements were screened by the judges. Every selected attitude towards digital technologies as agreed to by more than 80 per cent of the

judges. The validity of the scale was examined by discussing it with all the specialists of extension and academicians of CCS Haryana Agricultural University, Hisar, after the discussion the entire scale was found satisfied in term of the content validity.

Administration of the scale

The final scale which would measure the attitude of farmers towards digital technologies consisted of 10 statements. Each statement would be noted on a five-point continuum as strongly agree, agree, undecided, disagree, strongly disagree with scores of 5, 4, 3, 2 and 1, respectively for positive statements. Reversed scoring would be done in the case of negative statements. The score obtained for each statement would be summed up to arrive at the attitude score for the respondents. The score ranged from 50 (maximum) to 05 (minimum). Maximum score indicated a favourable attitude and minimum score indicated unfavourble attitude towards environmental conservation. The respondents would be categorized as 'less favourable', 'moderately favourable' and 'highly favourable' after getting the total attitude score based on the range values of the attitude score possible.

Table 1: Final selected statements on digital technologies

Final selected statements on digital technologies				
S No.	**Statements**	**S value**	**Q value**	**Remarks**
1.	Digital technologies are more expensive to buy.	2.41	1.56	Selected
2.	Digital technologies require more knowledge and skill to use them.	2.25	1.5	Selected
3.	Digital technologies con not be used by illiterate farmers.	2.83	2.19	Selected
4.	Farmers need discussion groups on use of such technologies.	0.25	2.095	Rejected
5.	Farmers need to be enthusiastic in learning and taking risk in usage of such technologies.	1.75	1.51	Selected
6.	Digital technologies should be designed in such a way that are easily available for farmers.	1.66	1.22	Rejected
7.	Digital technologies requires more labor.	3.75	2.31	Selected
8.	Only rich farmers can afford to take advantage of such technologies.	3.67	1.66	Selected
9.	Digital farmers once get damaged; they require more money in the aftermath for repairment.	3.22	1.66	Rejected
10.	Digital technologies are preferred for farmers with large land holdings.	2.92	2.37	Selected
11.	Awareness is the key factor among farmers to purchase and use such digital technologies.	0.3	1.8	Rejected
12.	Proper training is needed on how to use such digital technologies.	2.5	1.07	Selected
13.	Digital technologies requires farmers cooperation with the machine they are using.	0.5	1.24	Rejected
14.	Digital technologies saves time of farmers while working in field.	2.5	1.17	Rejected
15.	Digital technologies requires more power supply.	2.17	1.22	Selected
16.	Digital technologies save petrol & diesel.	0.84	0.63	Rejected
17.	Digital technologies helps in knowing the cropping pattern in the field.	0.65	1.15	Rejected
18.	Digital technologies helps in knowing soil conditions of the field.	0.93	1.48	Rejected
19.	Digital technologies help in knowing the weather conditions required for the crop being sown in the field.	0.67	1.47	Rejected
20.	Digital technologies helps in knowing the exact amount of spray of fertilizers/insecticides/weedicides in the field.	0.17	1.38	Rejected
21.	Digital technologies helps in knowing the disease penetration in the field.	0.1	1.21	Rejected
22.	Digital technologies helps in knowing the irrigation supply required by the crop.	1	1.89	Rejected
23.	Digital technologies respond very quickly to the user with better communication.	1.41	1.45	Rejected
24.	The usage of digital technologies helps in reducing fatigue.	0.7	2.01	Rejected
25.	Older generation hardly wants to use digital technologies.	2.5	2.07	Rejected
26.	Digital technologies are preferred for male farmers only.	2.5	2.23	Rejected
27.	Digital technologies are successful in big cities and developed countries only.	2.5	2.36	Rejected
28.	Digital technologies yield productive results to the farmers.	1.39	1.65	Rejected
29.	Digital technologies reduces movement of farmers in the field.	0.2	1.35	Rejected
30.	Digital technologies helps in providing real time related information to the farmers.	2.5	0.57	Selected

Conclusion

The standardised scale would be useful in determining the intensity of farmers' attitudes, making it easier for policymakers to make the best judgments possible. Select items were shown to be highly trustworthy, valid, and statistically significant after a reliability and validity examination. The scale was able to distinguish between the farmer categories based on their responses during the reliability test. This is highly effective in quantification of behavioural aspects like attitude.

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