Asian Journal of Agricultural Extension, Economics & Sociology

Volume 42, Issue 2, Page 126-133, 2024; Article no.AJAEES.113199
ISSN: 2320-7027

Fostering Expertise: Designing and Standardizing a Knowledge Test for Agricultural Scientists

Aaysha Kamar [a*] and S. Helen [b]

[a] Department of Agricultural Extension, College of Agriculture, Vellanikkara, Kerala Agricultural University, Thrissur, Kerala, India.
[b] Central Training Institute, Kerala Agricultural University, Mannuthy, Thrissur, Kerala, India.

Authors' contributions

This work was carried out in collaboration between both authors. Author AK did the methodology development, data collection, statistical analysis, literature citation and initial draft and manuscript preparation. Author SH designed the study, fully guided and did review the manuscript. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAEES/2024/v42i22371

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/113199

Original Research Article

Received: 03/12/2023
Accepted: 08/02/2024
Published: 12/02/2024

ABSTRACT

The study adheres to a methodology for creating and standardizing test items designed to assess the knowledge of Agricultural scientists. Initially, 75 test items were identified through literature review. Subsequently, through consultation with experts, a refined set of 60 items emerged after screening, enhancement, and editing processes. These items underwent item analysis, including item difficulty index and discrimination index based on ratings from a panel of 60 experts. Thirty-four test items were retained for the standardization phase from the initial 60 items. To assess the validity of the test items, point biserial correlation was conducted, resulting in the final selection of 30 items for the knowledge test. The reliability of the test items was evaluated using the Spearman Brown split-half coefficient, yielding a value of 0.911, indicating high reliability and fairness for the study. Consequently, the standardized items proved the suitability for measuring the knowledge of Agricultural scientists.

**Corresponding author: E-mail: aayshakamar93@gmail.com;*

Keywords: Knowledge; agricultural scientist; Item difficulty index; item discrimination index; validity; reliability.

1. INTRODUCTION

A knowledge test is a method of evaluation used to gauge an individual's understanding and proficiency in a specific subject or field. The questioning format can vary, including multiple-choice questions, true/false statements, short-answer queries, essays, or practical demonstrations. This helped for objective evaluation, identifying strength and weakness, measuring learning outcomes and continuous improvements. The ultimate purpose of a knowledge test was to assess how well an individual has acquired and retained information pertinent to the designated domain.

A scientist is an individual involved in systematic exploration and investigation within the realm of scientific inquiry. They operate in a wide array of scientific fields. These professionals dedicate themselves to understanding and elucidating natural phenomena through methods such as observation, experimentation, and analysis. The outcomes of their work contribute significantly to the expansion of knowledge and technological progress by shaping comprehension of the world and addressing complex societal challenges.

Testing the knowledge of scientists help validate the expertise of scientists in their respective fields by ensuring that they possess the basic knowledge. Testing knowledge allows scientists to identify areas of strength and weakness in their understanding and can guide ongoing professional development by helping scientists stay current in their fields. Knowledge testing of scientists is a fundamental aspect of maintaining the integrity, credibility, and progress of scientific endeavours. It serves both individual and collective interests by promoting continuous learning, specialization, and the pursuit of accurate and impactful knowledge.

2. METHODOLOGY

2.1 Selection of respondents

Sixty agricultural scientists specialized in agricultural extension from research, extension and academic centers of Kerala Agricultural University and Indian Council of Agricultural Research (ICAR) institutes were selected using simple random sampling technique.

2.2 Data Collection

For standardizing the items, the procedure suggested by Anastasi [1] and followed by Naveenkumar and Sendilkumar [2] and Nagam and Husain [3] were adopted in this study. The steps in developing items for knowledge test include collection of items, item analysis, standardization of items and final selection of items for the test as followed by Vijayan et al. [4].

2.2.1 Collection of items

The test items have been developed from an array of sources, including literature, interactions with scientists, experts, and researchers. The above-mentioned items were gathered after consulting with experts in the field of agricultural extension and by concentrating on a different facet of the agricultural knowledge that are expected to be possessed by an agricultural scientist.

2.2.2 Item analysis

Following a screening process using a five-point response continuum, the items were given to a panel of judges who determine the relevancy for each item via postal, Google forms, and personal visits. This was done to filter away weak and irrelevant content. Two indices viz; item difficulty index, and item discrimination index were used in the item analysis after relevancy rating.

The items were administered among non-sample respondents. Each correct answer earned one point, while the incorrect response received zero. The respondent's knowledge score was determined by the total number of right responses they provided out of all the items. The total score obtained by each respondent was calculated, and then they were ranked from highest to lowest. The respondents were separated into six equal groups using this analysis. These groups were designated as G1, G2, G3, G4, G5, and G6. The intermediate two groups, G3 and G4, were excluded, leaving only four extreme groups with high and low scores for item analysis Bloom et al. [5].

2.2.2.1 Item Difficulty Index

The difficulty value of an item refers to the proportion or percentage of individual who

answers the item correctly Garrett [6]. The item difficulty index indicates the extent to which an item is difficult. The index of difficulty was worked out by averaging the proportion of number of respondents answered correctly in high group and the proportion of number of respondents answered correctly in low group. The formula for determining the index on the basis of the extreme groups was:

$$p = \frac{n_i}{N_i} \times 100$$

where,

p = index of difficulty
n_i = Number of respondents answering correctly to i^{th} item
N_i = Number of respondents to whom i^{th} item was administered

The p value ranges from 0 to 100. Whereas Althouse [7] stated that items with p-value more than 80 should be considered as very easy and items less than 20 should be considered as very difficult and so, they should be subjected for revision.

Table 1. Evaluation criteria for item difficulty index

p value	Interpretation
< 20	Item is difficult, need revision
20 – 80	Item is appropriate
> 80	Item is very easy, not trustworthy

2.2.2.2 Item Discrimination Index

The discrimination power of a test item refers to the extent to which an item discriminates well informed individual from poorly informed one.

The discrimination power of all the items was worked out using the E1/3 method to find out the item discrimination Ghouse et al. [8]. The discrimination index obtained by calculating $E^{1/3}$ formula given by Mehta [9].

$$E^{1/3} = \frac{(S_1+S_2)-(S_5+S_6)}{N/3}$$

where,

S_1, S_2, S_5 and S_6 = Frequency of correct answer in groups
N = Total number of respondents of the selected sample

The discrimination index ranges from -1 to +1. Higher the value, more is the discrimination power. Items having negative discrimination and items with discrimination index below 0.1 were rejected as followed by Barman and Kumar [10].

2.2.3 Standardization of items

For standardization of a test items, validity and reliability are the two test requisites.

2.2.3.1 Validity test of the items

Validity of the test as the accuracy with which it measures that which is intended to measure Lindquist [11]. This is to find out the internal consistency of the items.

2.2.3.2 Point biserial correlation

The point biserial correlation provide information on how well item measures in agreement with the rest of the test. A correlation between a continuous and a dichotomous variable is known as the point-biserial correlation Demirtas and Hedeker [12]. It was calculated by using the formula as suggested by Kumar et al. [13].

$$r_{pbis} = \frac{MP-MQ}{SD} \times \sqrt{pq}$$

where, r_{pbis} = Point biserial correlation

MP = Mean of the total score of the respondents who answered the items correctly

$$MP = \frac{Sum\ of\ XY}{Total\ number\ of\ correct\ answers}$$

X = Total score of the respondent for all items
Y = Response of the individual for the item

MQ = Mean of the total score of the respondents who answered the items incorrectly

$$MQ = \frac{sum\ total\ of\ X - sum\ total\ of\ Y}{Total\ number\ of\ wrong\ answers}$$

SD = Standard deviation of the entire sample
p = Proportion of the respondents giving correct answer to the item

$$p = \frac{Total\ number\ of\ correct\ answers}{Total\ number\ of\ respondents}$$

q = Proportion of the respondents giving incorrect answer to the item
q = 1- p

Items having significant point biserial correlation either at 1 per cent or 5 per cent level was selected for the final test of knowledge as followed by Beevi et al. [14].

2.2.4 Reliability test of the items

To evaluate the reliability of the test items, the split-half method was applied. This benefit of this method is that it only requires one administration of the items to get the data set required for the test. This approach reveals the uniformity of the test. The response was split into two halves depending on the statements' odd and even numbers. Two sets of responses to two sets of items result in two sets of scores. To determine the test's dependability, the results were correlated. Using the Spearman-Brown prophecy formula, the reliability coefficient of the entire test was calculated as follows:

Reliability coefficient of the whole test = [2×(reliability coefficient of the half test)] / [1+(reliability coefficient of the half test)]

The positive and significant correlation between the two sets of the scores indicate that the items are reliable. The final selected items were taken as test item for knowledge test to scientists.

3. RESULTS AND DISCUSSION

3.1 Collection of Items

Expert opinions help ensure that the test items are valid, relevant, and reflective of the targeted knowledge. After consulting with experts, I had decided to retain certain items based on their feedback and insights. The 75 test items were gathered after consulting with experts. 60 items were retained after screening, improvising, and

Table 2. Item analysis of the developed items

Sl. No.	Item	Item difficulty index	Item discrimination index	Sl. No.	Item	Item difficulty index	Item discrimination index
1	S1	86.67	0.20	31	S31	70	0.2
2	S2	70	-0.1	32	S32	70	-0.1
3	S3	73.33	0.1	33	S33	70	0.9
4	S4	66.67	-0.6	34	S34	43.33	0.5
5	S5	86.67	-0.1	35	S35	40	0.8
6	S6	80	0.5	36	S36	53.33	0.3
7	S7	26.67	-0.2	37	S37	46.67	0.9
8	S8	86.67	0.2	38	S38	50	0.2
9	S9	93.33	0.2	39	S39	63.33	-0.1
10	S10	63.33	0.5	40	S40	60	0.7
11	S11	33.33	0.3	41	S41	56.67	-0.8
12	S12	70	0	42	S42	80	0.4
13	S13	40	-0.1	43	S43	80	0
14	S14	40	0	44	S44	56.67	0.5
15	S15	63.33	0	45	S45	73.33	0
16	S16	83.33	0.5	46	S46	26.67	-0.2
17	S17	33.33	0.1	47	S47	80	0
18	S18	36.67	0.2	48	S48	40	0.8
19	S19	76.67	-0.1	49	S49	66.67	0.2
20	S20	66.67	0.5	50	S50	40	0.3
21	S21	76.67	0.3	51	S51	56.67	0.9
22	S22	53.33	-0.3	52	S52	66.67	-0.1
23	S23	46.67	1	53	S53	53.33	0.4
24	S24	46.67	1	54	S54	60	0.3
25	S25	56.67	0.9	55	S55	33.33	0.4
26	S26	36.67	0.4	56	S56	46.67	-0.4
27	S27	70	0.4	57	S57	63.33	0.5
28	S28	30	0.7	58	S58	50	0.5
29	S29	40	0.4	59	S59	30	0.3
30	S30	33.33	-0.1	60	S60	43.33	0.5

editing on the advice of relevant specialists. These items were subjected to item analysis.

3.2 Item Analysis

The 60 items were given to a panel of 100 judges for relevancy rating. Only 60 experts responded back. The result of item analysis is shown in Table 2.

Among the 60 items, those items with item difficulty index below 20 and above 80 were eliminated. And those items having discrimination index below 0.1 was found to be inappropriate for the knowledge test. The item difficulty index between 20 to 80 and item discrimination index above 0.1 was selected. Therefore, 34 items were selected and retained for further standardization of test items.

3.3 Standardization of Items

3.3.1 Validity test of the items

The result of item validity test is shown in Table 3. Items having point biserial correlation value is significant either at 1 per cent or 5 per cent level and was selected for the final test of knowledge. Therefore, 30 items were selected.

3.3.2 Reliability test of the items

The Spearman Brown reliability coefficient for the 30 test items was found to be 0.911. Since, the reliability coefficient was positive and significant, the test items were reliable.

3.4 Administration of the Test and Final Scoring

The final selected items were considered as test items for knowledge test to scientists. The knowledge test for agricultural scientists consisted of 30 test items [Appendix]. These items with four choices each were administered to the respondents. Every correct answer was assigned with one score while every incorrect response was assigned with zero score. Summation of the obtained score by each respondent was the knowledge score of the individual. Based on the scores obtained by the respondents, they were categorized into three categories as mentioned in the Table 4.

The item analysis and other statistical analysis were done using IBM SPSS 16.0 and R.3.1 version.

Table 3. Point biserial correlation of the developed items

Sl. No.	Item	Point biserial correlation	Sl. No.	Item	Point biserial correlation
1	S6	0.486**	18	S36	0.443*
2	S10	0.651**	19	S37	0.704**
3	S11	0.439*	20	S38	0.430*
4	S18	0.468**	21	S40	0.575**
5	S20	0.651**	22	S42	0.2
6	S21	0.512**	23	S44	0.434*
7	S23	0.845**	24	S48	0.710**
8	S24	0.845**	25	S49	0.297
9	S25	0.606**	26	S50	0.440*
10	S26	0.371*	27	S51	0.606**
11	S27	0.424*	28	S53	0.294
12	S28	0.704**	29	S54	0.530**
13	S29	0.756**	30	S55	0.584**
14	S31	0.403*	31	S57	0.651**
15	S33	0.706**	32	S58	0.567**
16	S34	0.536**	33	S59	0.273
17	S35	0.495**	34	S60	0.421*

**Significant at 1 per cent level, **Significant at 5 per cent level*

Table 4. Criteria for categorizing Agricultural Scientists into different categories based on knowledge score

Category	Score range
Low	≤ Mean – SD
Medium	Mean ± SD
High	≥ Mean + SD

4. CONCLUSION

The standardization of knowledge test ensured that the assessment was fair, reliable, and valid, thereby providing an accurate measure of an individual's understanding and expertise in the relevant field. To measure the knowledge level, each test item with multiple choice should be given. It is advised to authenticate the test items for their functionality and applicability based on the research population.

ACKNOWLEDGEMENTS

The primary author is a doctoral research scholar who has produced this article as a result of her doctoral research conducted at Kerala Agricultural University. The research has been financially supported by the university. Nevertheless, the author bears full responsibility for the accuracy of the facts, the expression of opinions, and the formulation of conclusions presented in the article. The comprehensive study carried out by her under the auspices of Kerala Agricultural University delves into the intricate aspects of the subject matter.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Anastasi A. Psychological Testing. The Macmillan Company: New York; 1961.
2. Naveenkumar G, Sendilkumar R. Item analysis methodology to measure the knowledge of farmers on eco-friendly farm technologies in rice cultivation. J. Krishi Vigyan. 2015;4(1):56-59.
3. Nagam KK, Husain AS. A standardised knowledge test to measure the extent of knowledge of agricultural extension personnel on m-tools. J. Ext. Educ. 2016;28(1):5614-5619.
4. Vijayan B, Nain MS, Singh R, Kumbhare NV, Kademani SB. Knowledge test for extension personnel on Rashtriya Krishi Vikas Yojana. Indian J. Ext. Educ. 2023;59(1):131-4.
5. Bloom BS, Engelhardt M, Furnst E, Hill W, Krathwhol DR. Taxonomy of educational objectives: The cognitive domain. Longmans Green: New York; 1956.
6. Garrett HE. Statistics in psychology and education. Vakils, Feffer and Simons Ltd: Mumbai; 1979.
7. Althouse LA. Test development: Ten steps to a valid and reliable certification exam. In: Proceedings of the Twenty Eighth Annual SAS Users Group International Conference Paper. 2000:244.
8. Ghouse LM, Karthikeyan C and Devi MN. Developing a test to measure the knowledge level of farmers towards market intelligence. Asian J. Agric. Ext. Econ. Soc. 2022;40(10):1131-1136.
9. Mehta P. A study of communication of agricultural information and the extent of distortion occurring from district to village level working in selected IADP District. Ph.D. Thesis. Submitted to the University, Udaipur, Rajasthan; 1958.
10. Barman U, Kumar B. A test to measure knowledge of extension personnel on farmers' group dynamics. Indian Research J. Ext. Educ. 2010;10 (3):119-123.
11. Lindquist EF. (Ed.). Educational measurement. American Council on Education, American Psychological Association: Washington D. C. 1951;819.
12. Demirtas H, Hedeker D. Computing the point-biserial correlation under any underlying continuous distribution. Communications in Statistics-Simulation and Computation. 2016;45(8):2744-2751.
13. Kumar R, Slathia PS, Peshin R, Gupta SK, and Nain MS. A test to measure the knowledge of farmers about rapeseed mustard cultivation. Indian J. Ext. Educ. 2016;52(3&4):157-159
14. Beevi Anshida CN, Nirmala G, Rohit J, Nagasree K, RaviShankar K, Raju BMK, Dhimate SA and Singh VK. Knowledge test for rainfed farmers on natural resource management practices. Indian J. Ext. Educ. 2022;58(4):159–162.

APPENDIX I

Final items for knowledge test

Please choose the correct answer from the multiple choices given below against each question by putting a tick (✓) mark

1	"T" in NITI Ayog stands for			
	a) Technology	b) Transforming	c) Transferring	d) Transmission
2	e-commerce company launched an online platform for organic farming products is			
	a) Amazon	b) Flipkart	c) Alibaba	d) eBay
3	Which crop faced significant yield losses due to an outbreak of a new strain of fungal disease in 2023			
	a) Rice	b) Maize	c) Wheat	d) Soyabean
4	Country recently launched the world's first-ever "Vegan Silk" from proteins of apples and bananas			
	a) India	b) USA	c) China	d) Brazil
5	Regulated market ensures			
	a) Procurement price	b) Support price	c) Remunerative price	d) Fair price
6	Forest Research Institute is situated at			
	a) New Delhi	b) Goa	c) Dehradun	d) Mumbai
7	Blanket flower is			
	a) Cock's comb	b) Gaillardia	c) Ice plant	d) sweet sultan
8	Name of new regulatory body to replace UGC under consideration by Government of India			
	a) NKC	b) NEP	c) HECI	d) None of these
9	Age limit for candidate to apply for UGC-NET Assistant Professor			
	a) No limit	b) 31 years	c) 32 years	d) 33 years
10	National Educational Policy 2020 is an educational policy released after ……. Years			
	a) 24 years	b) 34 years	c) 44 years	d) 54 years
11	Maximum GST rate imposed			
	a) 22%	b) 26.5%	c) 28%	d) 29%
12	Father of Agriculture is			
	a) Norman E Borlaug	b) Haberlandt	c) Rudolf Steiner	d) William S Gaud
13	Year in which Krishi Bhavan established in Kerala was			
	a) 1985	b) 1986	c) 1987	d) 1988
14	National Farmers Day is celebrated on……..			
	a) April 24	b) June 1	c) Dec 23	d) Mar23
15	The year in which Kerala witness worst floods in recent history, causing extensive damage to agriculture and infrastructure			
	a) 2017	b) 2018	c) 2016	d) 2015
16	In which state farmers are the richest in India			
	a) Maharashtra	b) Assam	c) Meghalaya	d) Punjab
17	First organic district in Kerala			
	a) Alappuzha	b) Palakkad	c) Kasaragod	d) Thrissur
18	Which is the largest agriculture state in India			
	a) Uttar Pradesh	b) Rajasthan	c) Madhya Pradesh	d) Andhra Pradesh
19	Which country is No:1 in agriculture?			
	a) India	b) USA	c) Brazil	d) China
20	Which sate in India has the best soil suited for agriculture			
	a) Tamil Nadu	b) Madhya Pradesh	c) Punjab	d) Gujrat
21	Which crop has been promoted under the "Subhiksha Keralam" project for sustainable agriculture in Kerala?			
	a) Rubber	b) Coconut	c) Banana	d) Vegetables
22	Tag colour of foundation seed is			
	a) White	b) Blue	c) Green	d) No tag colour
23	International publication of KAU is			

	a) International Journal of Agricultural Research b) Journal of Agriculture c) Journal of Tropical Agriculture d) Journal of Horticulture
24	Recently released rice variety from RRS, Vyttila suitable for Pokkali regions a) KAU Pournami b) KAU Lavanya c) KAU Jyothsna d) Vyttila-9
25	Plant nutrient mixture KAU Sampoorna can be used in a) Rice b) Banana c) Vegetable d) All of these
26	Plagiarism checking software used by KAU a) Urkund b) iThenticate c) Turnitin d) Viper
27	Ready platform for agricultural libraries of Indian National Agricultural Research and Education system (NARES) a) CeRA b) IDEAL c) CABI e-book d) CAB abstract
28	ICAR with the assistance of NAHEP and GoI, CAAST project was funded by a) NABARD b) RBI c) World bank d) SBI
29	State recently declared Internet access as a fundamental right for its citizens a) Tamil Nadu b) Kerala c) Maharashtra d) Karnataka
30	Coconut day is celebrated on …….. of every year a) July 28 b) Dec 4 c) Sep 2 d) Feb 2

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/113199