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Knowledge Testing Options in Pre-Test Post-Test Evaluation Design: Implications for Extension Program Evaluation

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Abstract

Knowledge gained is an important outcome indicator used in the evaluation of extension education programs. Three evaluation designs commonly used to document extension program participants' knowledge change are: (a) objective knowledge pre-test, post-test design, (b) subjective knowledge pre-test, post-test design, and (c) subjective knowledge retrospective pre-test, post-test design. This study was designed to examine the relationship between measuring variables of objective knowledge pre-test, post-test, and subjective knowledge pre-test, post-test designs, and to examine the validity of subjective knowledge pre-test and post-test designs in assessing the knowledge gained by the Cook Smart Eat Smart extension participants. The researchers developed the survey instrument to document objective knowledge and subjective knowledge. The survey was administered before and after completing the training. The study received 71 responses. Paired sample t-test and correlation analysis were used to achieve research objectives. The findings indicate that all three designs are effective in documenting the changes in participants' knowledge. Findings also verified the accuracy and validity of the subjective knowledge retrospective pre-test and post-test design. The evaluation of extension programs is strengthened by evidence demonstrating the validity of both objective and subjective measures for assessing knowledge gain, a key outcome indicator in extension education.

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Introduction and Problem Statement

Documenting knowledge change is central to evaluating extension programs because learning often influences behavior and long-term outcomes (Bennett, 1975). Extension professionals, therefore, must consider how to best measure knowledge improvement when assessing program effectiveness (Diaz et al., 2021).

Objective pre-test and post-test designs are often considered the most rigorous approach. Objective knowledge reflects what participants actually know, measured through factual tests (Brucks, 1985). Capturing changes between two points provides strong evidence of learning (Ary et al., 2006; O'Leary & Israel, 2019). However, these instruments require considerable time to develop and administer. In shorter programs, testing may also reduce instructional time and create participant fatigue, especially when surveys are lengthy.

To address these challenges, many extension professionals employ subjective pre-test and post-test measures, which assess what participants believe they know (Brucks, 1985). Findings regarding how subjective and objective knowledge align are inconsistent. Several studies report moderate to strong positive correlations (Brucks, 1985; Raju et al., 1995), while others report weak or no correlation (Carlson et al., 2009; Ellen, 1994; Farrell et al., 2010). This inconsistency raises concerns about validity (Joshi et al., 2024).

The lack of consensus creates a problem for extension evaluation: subjective measures are practical but may not accurately reflect actual knowledge change. This uncertainty limits professionals' ability to select designs that balance feasibility with validity. In response to this gap, the current investigation evaluates the effectiveness of subjective pre-test and post-test designs relative to objective testing for measuring knowledge gains in the Cook Smart, Eat Smart extension program.

Conceptual Framework

With knowledge as a construct defined as "the information stored within memory" (Engel et al., 1993, p. 281), the subjective knowledge assessments are designed to record training participants' perceived knowledge about the subject (Spreng & Olshavsky, 1990). The subjective knowledge testing instruments are designed with some statements related to the testing of knowledge and recording participants' level of responses on a Likert scale. This design requires developing a knowledge baseline through the administration of a pre-test at the beginning of the training and a post-test at the end of the training to assess knowledge gains, which creates an additional onus of time on participants to complete the evaluation. Therefore, this design may be time-intensive and not suitable for the assessment of short training programs. Another limitation of this subjective pre-test and post-test design is its possible measurement errors due to response-shift bias of participants (Chasteen & Chattergoon, 2019; Moore & Tananis, 2009; Thomas et al., 2018). A response-shift bias occurs when individuals inaccurately rate their own knowledge on a pre-test because they lack sufficient understanding of the subject to provide an

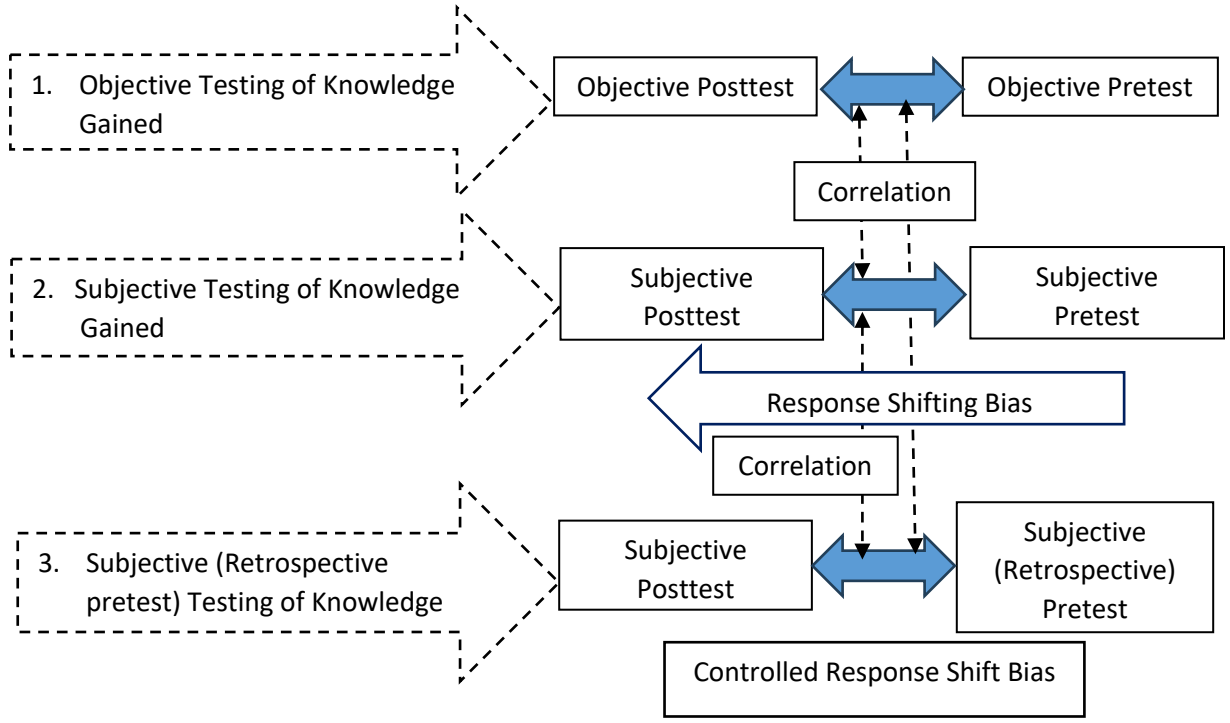
informed assessment (Nielsen, 2011). This is a serious issue when extension agents deliver programs on unfamiliar topics because participants often lack the necessary context to accurately gauge their prior knowledge, which can lead them to rate their perceived knowledge as high at the outset before being exposed to the content. After completing the training, they realized that they knew only a little about the subject and rated relatively low on the post-test. This shifting of response bias may fail to capture changes in knowledge that occur between pre-test and post-test assessments. It is a problem with the design due to the shifting response bias of participants (Chasteen & Chattergoon, 2019; Nielsen, 2011).

Extension professionals use the subjective knowledge retrospective pre-test and post-test design as an alternative to overcome the above-discussed response-shift bias of subjective knowledge testing pre-test and post-test design. Retrospective pre-test post-test design, also known as the then-test design, provides the same frame of reference to measuring variables and controls the response shifting bias (Drennan & Hyde, 2008; Nielsen, 2011; Taminiau-Bloem et al., 2015). Providing the same frame of reference is a requirement to consider that pre-test and post-test comparisons are valid (Howard, 1980). Additionally, retrospective pre-test and post-test evaluation design is more sensitive to changes in respondents than traditional pre-test and post-test evaluations (Skeff et al., 1992). The retrospective subjective pre-test/post-test design is becoming an increasingly popular option for evaluating extension programs, particularly because it only requires administration once at the end of the training. This approach is considered more accurate for capturing self-reported knowledge gains, as participants can reflect on both their baseline knowledge and what they learned after completing the program. Researchers have recommended this method for assessing short-term training programs, as it avoids the need for pre-program administration and preserves more time for instruction (Nielsen, 2011). Retrospective pre-test documents self-reported data, leading to generate an estimated evaluation report (Pratt et al., 2000), which is different from an actual (objective) knowledge test report.

The available literature (Chasteen & Chattergoon, 2019; Taminiau-Bloem et al., 2015; Thomas et al., 2018) is inconsistent in the validity of these subjective knowledge pre-test and post-test designs compared to the objective knowledge pre-test and post-test design. This study aims to test the validity of the subjective knowledge pre-test and post-test design, and the subjective knowledge retrospective pre-test and post-test design compared to the objective knowledge pre-test and post-test design. Figure 1 provides the conceptual frame of comparing three designs of knowledge testing, i.e., 1) objective knowledge pre-test post-test design, 2) subjective knowledge pre-test post-test design, and 3) subjective knowledge retrospective pre-test post-test design.

Figure 1

Comparison of the Effectiveness of Three Designs of Evaluations for Assessing Participants' Knowledge Gained



Purpose

The present research aimed to compare the validity of three knowledge testing evaluation designs in the context of the Cook Smart, Eat Smart extension program. By examining the strengths and limitations of each design, this study provides insights that can guide practitioners in selecting evaluation approaches that balance rigor with feasibility in program settings. More precisely, this research sought to address these objectives:

1. To compare the validity of the objective knowledge pre-test and post-test design, the subjective knowledge pre-test and post-test design, and the subjective retrospective pre-test and post-test design in evaluating knowledge gains as a result of the Cook Smart Eat Smart extension program.
2. To determine the correlation between objective knowledge measurements and subjective knowledge measurements at pre-tests, post-tests, and retrospective pre-tests.
3. Determine the correlation between objective knowledge gained, subjective knowledge gained, and the retrospectively assessed subjective knowledge gained of Cook Smart Eat Smart participants.

4. To assess the relative accuracy of the subjective (perceived) pre-test and post-test knowledge assessment design and the retrospective pre-test and post-test design in evaluating an extension program.

Methods

This evaluation study was conducted using the Cook Smart, Eat Smart extension program. Three Family and Consumer Sciences (FCS) County Extension Agents were selected based on recommendations from the state FCS program leader. Each of the selected agents had prior experience delivering the Cook Smart, Eat Smart curriculum. This multi-session program is designed to help participants build practical cooking knowledge and skills that can be applied at home. The first author reached out to the agents in North Carolina State to explain the purpose of the study, outline the key data collection points, and emphasize the importance of collecting complete and accurate data.

Researchers developed the required evaluation instruments by reviewing the Cook Smart Eat Smart curriculum and relevant literature to collect research data. The pre- and post-survey instruments were pilot tested with a similar group of training participants to establish face validity. A panel of extension and evaluation experts reviewed the instrument and established content validity. The data collection instruments included the pre-test instrument and the post-test instrument. The pre-test instrument included two components: a 25-item objective knowledge test using true/false/don't know questions based on the curriculum, and a 15-item subjective knowledge assessment using a 5-point Likert scale. The Likert scale ranged from 1 = very low to 5 = very high knowledge. The post-test survey consisted of three sections: an objective knowledge testing post-test, a subjective knowledge testing post-test, and a subjective knowledge testing retrospective pre-test and post-test. These are the same questions used in the subjective knowledge testing pre-test and the post-test. The score on the objective knowledge testing 25-factual-question tests can range from 0 = very low to 25 = very high. The subjective knowledge testing score recording on the 15-item scale can range from 15 = very low to 75 = very high. Cronbach's reliability Alpha of the subjective knowledge testing scale was .91.

The three selected Extension Agents were responsible for scheduling, advertising, and recruiting participants for the program. One agent conducted two training programs, enrolling 16 participants in one and 18 in the other, for a total of 34 individuals. The other two agents recruited 16 and 21 participants, respectively, for their programs. Each agent delivered the Cook Smart, Eat Smart curriculum across multiple sessions. The consent form and the pre-test were given at the beginning of the training program, and the post-test was administered at the end of the training. The study received 71 responses.

Data were analyzed using IBM SPSS 26®. We used paired sample t-test analysis and the Pearson product-moment correlation coefficient to accomplish objectives. We used Meghanathan's (2016) classification of correlation coefficients to describe our findings (see Table 1).

Table 1

Range of Correlation Coefficient Values and the Corresponding Descriptors

Range of Correlation Coefficient Values	Description
+/- .80 - 1.00	Very strong
.60 - .79	Strong
.40 - .59	Moderate
.20 - .39	Weak
- .19	Very weak

Findings

Findings are structured according to four primary objectives.

Objective 1: The Comparison of the Validity of Three Designs in Evaluating the Change in Knowledge of Cook Smart Eat Smart Participants

Paired-samples t tests were conducted to analyze data related to the first research objective. The paired-samples t-test findings in Table 2 indicate that the objective knowledge pre-test and post-test design, the subjective knowledge pre-test and post-test design, and the subjective knowledge test with retrospective pre-test and subjective knowledge post-test design are effective evaluation designs for measuring knowledge change (i.e., gain) among the Cook Smart, Eat Smart program participants. All three evaluation designs recorded a significant knowledge gain by participants from pre-test to post-test. Participants' knowledge gain was highly visible in the subjective knowledge retrospective pre-test and post-test design compared to the other two designs (see Table 2). The mean value of the subjective knowledge pre-test (45.1) was higher than the mean value of the subjective knowledge retrospective pre-test (43.4). This may be due to response shift bias (Chasteen & Chattergoon, 2019; Moore & Tananis, 2009; Thomas et al., 2018) in the subjective knowledge pre-test.

Table 2

The Comparison of Objective and Subjective Assessment of Knowledge Before and After Completing the Training

		M			
Type of knowledge testing design	*N*	Pre-test	Post-test	*t*	*p*
Objective knowledge pre-test and post-test	69	16.1	18.9	6.03	.001**
Subjective knowledge pre-test and post-test	58	45.1	59.0	7.86	.001**
Subjective knowledge test with retrospective pre-test and subjective post-test	52	43.4	59.0	11.34	.001**

Note. P**<.001

Objective 2: The Correlation Between Knowledge Test Scores of Three Designs

A moderate positive correlation was found between the objective pre-test and post-test scores, $r = .43$, $p < .05$ (see Table 3). In contrast, the correlation between subjective and objective pre-test scores was not significant, suggesting that the subjective pre-test did not reliably reflect participants' actual baseline knowledge. A weak but significant positive correlation was observed between subjective and objective post-test scores, $r(n-2) = .32$, $p < .05$.

Table 3

Pearson's Correlation Between Objective Assessment and Subjective Assessment of Knowledge Testing Scores

Variable	*n*	*M*	*SD*	1	2	3	4	5
Objective knowledge pre-test score	71	15.9	4.13	-				
Objective knowledge post-test score	69	18.9	2.91	.43**	-			
Subjective knowledge pre-test score	62	45.2	11.0	.12	.02	-		
Subjective knowledge post-test score	63	59.1	8.55	.43**	.32*	.119	-	
Subjective knowledge retrospective pre-test score	58	43.7	9.20	.40**	.26*	.45**	.41**	-

Note. P*<.05, P**<.001

A significant moderate positive correlation was found between the retrospective subjective pre-test score and the objective pre-test score, $r(n - 2) = .40$, $p < .001$. The retrospective subjective pre-test score was also weakly but positively correlated with the objective post-test score, $r(n - 2) = .26$, $p < .05$. In addition, moderate positive correlations emerged between the retrospective subjective pre-test score and the subjective pre-test score, $r(n - 2) = .45$, $p < .001$, as well as between the retrospective subjective pre-test score and the subjective post-test score, $r(n - 2) = .41$, $p < .001$.

Objective 3: The Correlation Between Participants' Knowledge Gains in Three Evaluation Designs

Knowledge gain was calculated by subtracting pre-test scores from post-test scores for each evaluation design. This produced gain scores for the objective pre-test–post-test, the subjective pre-test–post-test, and the retrospective subjective pre-test–post-test designs. Correlation analyses were then conducted to examine the relationships among these three gain measures (see Table 4).

Table 4

Pearson Correlations of Objective and Subjective Knowledge Measures

Variable	*n*	*M*	*SD*	1	2	3
Objective knowledge change between pre-test and post-test	69	2.8	3.87	-		
Subjective knowledge change between post-test and pre-test	58	13.8	13.46	.04	-	
Subjective knowledge change between the retrospective pre-test and the post-test	52	15.5	9.88	.04	.59**	-

Note. P**<.001

Table 4 shows that objective knowledge change was not significantly correlated with subjective knowledge change, including knowledge gains measured through the retrospective pre-test–post-test design. However, moderate positive correlations were observed among subjective knowledge gains across the traditional pre-test–post-test and retrospective pre-test–post-test measures.

Conclusions, Discussion, and Recommendations

This study examined the validity of three evaluation designs—objective pre-test/post-test, subjective pre-test/post-test, and subjective retrospective pre-test/post-test—in measuring change in knowledge among participants in the Cook Smart, Eat Smart Extension program. The findings confirm that all three designs were effective in documenting statistically significant knowledge gains, but their accuracy, practicality, and alignment with one another varied.

The objective knowledge pre-test/post-test design, often considered the most rigorous method for evaluating learning outcomes, directly measured factual knowledge using a set of 25 true/false questions with a “don’t know” option to reduce guessing error. This approach clearly demonstrated significant improvement in knowledge. However, its practical limitations, including the time required to develop the instrument, administer pre- and post-tests, and engage participants, make it less feasible for short programs or time-constrained settings. Participants’ reluctance to complete lengthy objective assessments is another drawback that may impact data quality and response rates.

The subjective knowledge pre-test/post-test design also showed significant increases in perceived knowledge. However, its accuracy is questionable. The absence of a significant correlation between subjective and objective pre-test scores raises concerns about participants’ ability to accurately assess their baseline knowledge before exposure to the content. This misalignment is likely due to response shift bias, where participants overestimate their knowledge at the outset because they are unaware of what they do not yet know (Chasteen & Chattergoon, 2019; Moore & Tananis, 2009; Thomas et al., 2018). Although there was a weak but statistically significant correlation between subjective and objective post-test scores, the

inconsistency between pre- and post-test measures undermines the credibility of this design when used alone.

In contrast, the subjective retrospective pre-test/post-test design not only recorded significant knowledge gains but also demonstrated more consistent alignment with objective knowledge measures. A moderate positive correlation was observed between the retrospective pre-test and objective pre-test scores (.40), and a weak correlation between the objective post-test and subjective post-test scores (.32), indicating participants' pre and post-program reflections were reasonably accurate compared to their actual prior knowledge and perceptions. Similarly, the moderate correlation between the retrospective pre-test and the subjective post-test (.41) further supports the internal consistency of this design. Although the correlation between subjective post-test and objective post-test scores was weak (.32), it still suggests some alignment between perceived and actual knowledge after the program.

These results provide strong support for the retrospective design as a practical and valid alternative, especially in settings where administering traditional pre-tests is not practical. The design effectively avoids the response shift bias common in standard subjective pre-test/post-test option (Drennan & Hyde, 2008; Nielsen, 2011; Taminiau-Bloem et al., 2015) and is easier to develop and administer. Its weak to moderate alignment with objective measures strengthens its credibility as a practical design in extension program evaluation.

Importantly, the analysis revealed no significant correlation between objective knowledge change and either form of subjective knowledge change. This disconnect reinforces concerns about the credibility of self-reported data in capturing actual learning gains. Participants may misjudge the extent of their improvement, either underestimating or overestimating their learning. Despite this, the moderate correlation between changes recorded by the subjective pre-test/post-test and retrospective pre-test/post-test designs suggests consistency in participants' perceptions of knowledge gain across both methods.

Taken together, these findings suggest that while objective evaluations remain the gold standard in terms of accuracy, the subjective knowledge retrospective pre-test and post-test design offers a highly practical and sufficiently credible alternative. When time, resources, or participant burden limit the use of objective methods, the retrospective design can provide meaningful insights into program effectiveness. It is especially well-suited for short-duration or introductory programs where participants lack the baseline knowledge needed to accurately assess themselves at the outset.

Recommendations and Implications

When conditions allow, the objective pre-test/post-test design should be used for its accuracy in capturing factual knowledge gain. However, in programs with time constraints or limited participant engagement, the retrospective pre-test/post-test design offers a more practical and credible alternative. The traditional subjective pre-test/post-test design may be used cautiously, keeping in mind the potential for response shift bias (Chasteen & Chattergoon,

2019; Moore & Tananis, 2009; Thomas et al., 2018) and the challenges participants face in evaluating their knowledge before exposure to new content.

The most significant implication of this study is that it affirms the validity and practicality of the subjective knowledge retrospective pre-test and post-test design as an effective evaluation tool for extension programs. This design strikes a balance between accuracy and feasibility and can improve the consistency and credibility of evaluation results across various program formats and audiences.

Limitations and Future Research

The research was conducted with a relatively small sample of participants from a single extension program in one state, which limits the generalizability of the findings to other programming contexts. Future research should replicate this study across multiple program areas, such as agriculture and 4-H, and in different states or regions to assess the broader applicability of these evaluation designs. Additional work is also needed to explore how factors such as audience characteristics, program duration, and content complexity influence the alignment between perceived and actual knowledge gains.

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