Journal of Integrated Pest Management, (2018) 9(1): 7; 1–4
doi: 10.1093/jipm/pmy001
Surveys and Needs Assessments

Using Immediate Feedback to Improve Short-Term Learning in Extension

Erin W. Hodgson

Department of Entomology, Iowa State University, 339 Science II, Ames, IA 50011 (e-mail: ewh@iastate.edu)

Subject Editor: Jeffrey Davis

Received 1 December 2017; Editorial decision 16 January 2018

Abstract

Program evaluation is an important part of any extension program and is often a required component by funding agencies. Given declining resources in land-grant universities, we must be creative in evaluating the learning and adoption of our research-based recommendations. I used a survey tool to give immediate feedback to participants in a wide variety of situations. Results indicate adults were receptive to this evaluation method, and close-ended questions can provide reliable evaluation data in an extension program. People showed improved significant learning with this technique and it is a model for other extension personnel.

Key words: soybean aphid, *Aphis glycines*, evaluation, survey

Program evaluation is a tool for demonstrating the value of extension to stakeholders, peers, and administration (Stup 2003, Caffarella and Daffron 2013). Smith et al. (1984) noted that evaluation planning, implementation, and reporting can also have practical benefits. Planning for evaluation before programs are delivered can increase the impact of programs by developing more comprehensive learning objectives. Implementing evaluations can identify knowledge and interest gaps, and allow for redirection of programming. Reporting evaluations can increase stakeholder interest and awareness.

Surveys are commonly used to collect information about peoples' knowledge and behaviors (Stup 2003, Caffarella and Daffron 2013, Fink 2017). University extension personnel are asked to document program impact, and, therefore land grant universities have developed a strong evaluation culture (Caffarella and Daffron 2013, Franz et al. 2014). University extension surveys are usually self-administered questionnaires prepared by program planners (Fink 2017). There are many ways to develop evaluation questions depending on what kind of information is being collected (Taylor-Powell 1998, Taylor-Powell and Hermann 2000, Fink 2017). Educators tend to think close-ended questions (e.g., multiple choice options) are easy to score, reliable, and quick to score (Taylor-Powell 1998); however, it can be difficult to force specific responses with certain topics (Epstein et al. 2002, Fink 2017).

Regardless of format, asking questions without providing corrective feedback does not facilitate learning and retention. Feedback is information the learners receive about their learning process; positive feedback enhances learner motivation and allots for self-adjustment (Caffarella and Daffron 2013). Epstein et al. (2002) stated, 'it is generally agreed that the best tests are those that teach while assessing'. Usually people want to know if they answered questions correctly and delaying the notification can actually cause anxiety (Epstein et al. 2002). By using active involvement in the evaluation process, the acquisition of correct information and retention increases (Epstein et al. 2002). Often questions are related to each other and answering incorrectly will result in similar errors later in survey. Understanding the correct answer can also help reinforce new learning.

The Immediate Feedback Assessment Technique (IFAT) developed by Epstein et al. (2001) promotes active knowledge acquisition and retention of subject materials. Epstein Educational Enterprises produces IFAT cards available for purchase (www.epsteineducation.com/home/about/) for about $0.20/card. The cards have a thin film covering the answer options (Fig. 1a). Just like a lottery ticket, participants scratch off an answer on the cards. If they select the correct response, a star appears within the rectangle and immediately reinforces the participants' understanding. If they select an incorrect response, the rectangle is blank and the participant can select another response. By using IFAT cards, participants will always discover the correct answer to every question if they keep trying (Fig. 1b).

An Example of Using IFAT for Extension

The invasive soybean aphid, *Aphis glycines* Matsumura, has been a significant economic pest in the North Central Region since 2000 (Ragsdale et al. 2007, Hodgson et al. 2012). Control costs and yield losses from soybean aphid results in United States $2.4–4.9 billion annually (Song et al. 2006). With the establishment of soybean aphid in the United States, foliar insecticide use on soybean has increased by 130% (Ragsdale et al. 2011). An economic threshold was developed (Ragsdale et al. 2007) and recently validated (Koch et al. 2016)

to help farmers target applications. From 2000–2015, foliar insecticides performed well, reducing populations below the economic injury level (Hodgson et al. 2012). Pyrethroid insecticides were a popular choice for soybean aphid management because the products had excellent efficacy and were relatively inexpensive (Hodgson et al. 2012). However, pyrethroid-resistant soybean aphids were first confirmed in Minnesota and Iowa (Hanson et al. 2017), and later in North Dakota and South Dakota (unpublished data).

A goal of my extension program at Iowa State University is to raise awareness of emerging crop protection issues, and offer integrated pest management (IPM) and insecticide resistance management (IRM) recommendations for stakeholders. The declining efficacy of commonly-used insecticide groups complicates management practices for this economic pest. In 2016–2017, I used IFAT to evaluate current IPM practices for soybean aphid and awareness of pyrethroid resistance at 12 extension meetings in Iowa. Being face-to-face with meeting participants conveyed the importance of the evaluation, and involved them in a unique and active learning process. I followed a survey checklist and analyzed survey results to determine if IFAT significantly influenced short-term learning in an extension context (Taylor-Powell 1998 and Taylor-Powell and Hermann 2000; Table 1). I used IFAT cards because I have limited funding for immediate feedback compared to other techniques (e.g., remote clickers) and wireless internet is not always available at extension venues.

Evaluation Methods

Between November 2016 and January 2017, I spoke about soybean aphid for about 50 min at 12 extension events in Iowa. Participants received an IFAT card as they walked in the room. Each card had ten 4-answer choices—questions 1–5 were for the pretest and questions 6–10 were for the posttest (Fig. 1). Participants remained anonymous to increase the response rate (Taylor-Powell and Hermann 2000, Fink 2017). Three learning objectives were outlined at the beginning of each presentation 1) distinguish insecticide groups, 2) understand

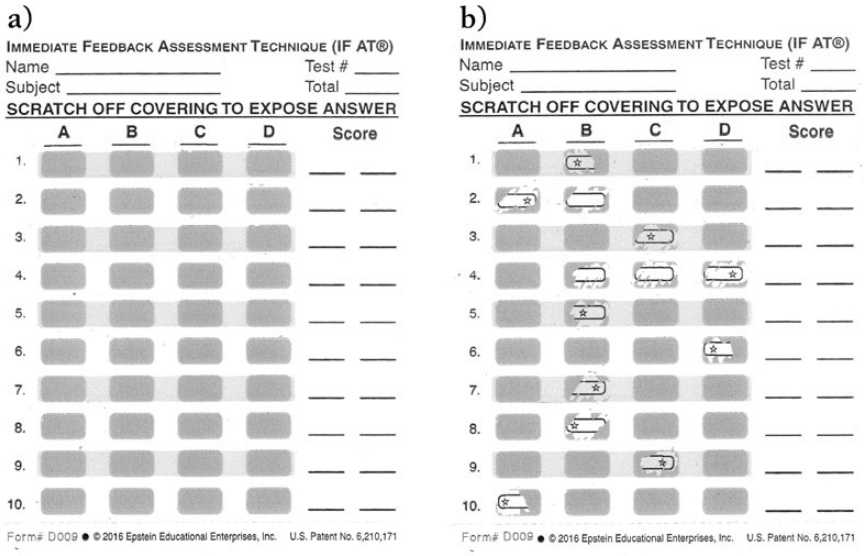

Fig. 1. Example of immediate feedback cards, including (a) a new card and (b) a completed card. Note the participant incorrectly answered questions 2 and 4, but was able to try again and eventually select the correct responses.

Table 1. Steps to developing an extension survey (modified from Taylor-Powell 1998 and Taylor-Powell and Hermann 2000)

Survey progression	Additional notes for consideration
1. Assemble a team	Who should be involved (e.g., peers, collaborators, and stakeholders)?; delegate assignments
2. Prepare a budget and timeline	Estimate cost for entire project (e.g., printing, postage, software, salaries/wages, mileage, etc.); break-up progression steps into realistic deadlines
3. Define objectives and goals	What is the scope of project (geographic, level of expertise, etc.)?
4. Identify key respondents	Who is the target audience? How are they best reached? Will results be anonymous? Does it require IRB (institutional review board)/administrative approval?
5. Select methodology	What is the setting (e.g., paper, in-person, phone, electronic), best time of year and venue to distribute? How much time will it take? Who needs to help? How many locations are desired? Ideal number to reach/complete?
6. Refine questions	How many questions should be included? Question format? What is nice to know and what is essential to know?
7. Arrange pilot test	Distribute to people with similar backgrounds to your target audience; make revisions as necessary until finalized
8. Deliver	Keep it the same; keep it confidential
9. Summarize and analyze data	How can the data be interpreted? How will be reported/published? How will the data be summarized (e.g., by hand or electronically)?
10. Disseminate results	How will the survey results be shared (format)? Who will see the results?

IPM and IRM tactics for soybean aphid, and 3) raise awareness of soybean aphid resistance issues. After reviewing the learning objectives, I announced the plan for a 'pretest versus posttest' style quiz, comprised of the same set of questions asked at the beginning and end of the session. I asked people to use a pen or key to scratch the cards. I designed multiple-choice questions to produce a uniform response (Taylor-Powell 1998). Five questions were embedded into a PowerPoint presentation, with one question and four possible answers displayed per slide:

1. Foliar insecticides used for Iowa field crop insect pests attack what system: 1) respiration, 2) nervous, 3) digestion, or 4) development and growth.
2. A resistance management plan for soybean aphid should include the following tactics: 1) rotating insecticide groups and host plant resistance, 2) crop rotation and a late planting date, 3) host plant resistance and narrow row spacing, or 4) rotating insecticide groups and a late planting date.
3. The most common foliar insecticide groups used in Iowa field crops are: 1) 2 and 4, 2) 1 and 4, 3) 1 and 3, or 4) 3 and 4.
4. Threats for managing soybean aphid in the next 5 yr include: 1) restrictions on insecticide options, 2) complicated aphid biology, 3) soybean economics, or 4) all of the above.
5. In 2016, there were performance issues with soybean aphid and what insecticide group in Iowa: 1) organophosphates, 2) pyrethroids, 3) neonicotinoids, or 4) sulfoximines.

During the 'pretest', participants using the IFAT cards instantly knew if they answered questions correctly or could continue to guess until they did select the correct answer (Fig. 1b). I did not review the correct answers before starting my presentation and this may have induced anxiety for some participants (Epstein et al. 2002, Caffarella and Daffron 2013). However, I assured the groups I would address all the evaluation questions during the session. During the 'posttest' at the end of the session, I asked the same questions and four possible answers; I did rearrange the answer order. Learning objectives were also mentioned at the end of the presentation as a form of repetition. I collected cards at the end of each session and kept them separated by location.

Evaluation Analysis

Some participants did continue to guess if they did not initially answer correctly, but some did not try to get the correct answer. I assumed if there were multiple guesses for a question, they initially answered incorrectly. Some participants did not answer one or more questions of the pretest or posttest, which resulted in nonresponses (i.e., blanks) in the data collection. I assumed these nonresponses in each question are missing at random for all participants in each location. Data were weighted to adjust for question nonresponses from the participants. Weighting is a common statistical method used to emphasize a population. After weighting, the sample can be representative of the target population with respect to variables measured in the survey. Under this assumption, the respondent data for each pair of questions (i.e., before and after presentation) represents a population as if all participants responded to the question item both before and after presentation. In other words, I assumed nonresponses were incorrect answers. The weights are the reciprocal of the response rate for each question item pair.

After weighting, a Rasch model was set up to describe the short-term learning effect and the individual-level ability (Rasch 1980). The Rasch model is a psychometric model for analyzing categorical data, such as answers to questions on a reading assessment or questionnaire responses, as a function of the trade-off between 1) the respondent's abilities, attitudes or personality traits and 2) the item difficulty (https://www.rasch.org/rmt/rmt213d.htm). The model included the following notations:

i: location index, $i = 1, \ldots, 12$
n_i: total number of participants in the i^{th} location
j: participant index, $j = 1, \ldots, n_i$
k: question item index, $k = 1, \ldots, 5$
α_{ijk}: the ability of participant j in location i to the question item k before learning
β: the short-term learning effect of the program
$Y_{ijk,0}$: binary response indicator of participant j in location i to the question item k before learning, where $Y_{ijk,0} = 1$ represents the correct answer and $Y_{ijk,0} = 0$ represents the wrong answer
$Y_{ijk,1}$: binary response indicator of participant j in location i to the question item k after learning, where $Y_{ijk,1} = 1$ represents the correct answer and $Y_{ijk,1} = 0$ represents the wrong answer

Lastly, data were fitted using this Rasch model for each participant response with the following equations:

$$\Pr(Y_{ijk,0} = 1) = \frac{\exp(\alpha_{ijk})}{1 + \exp(\alpha_{ijk})}$$

and

$$\Pr(Y_{ijk,1} = 1) = \frac{\exp(\alpha_{ijk} + \beta)}{1 + \exp(\alpha_{ijk} + \beta)}$$

Comparing these two probabilities, the conditional joint probability was formulated:

$$\Pr(Y_{ijk,0} = 0, Y_{ijk,1} = 1 | Y_{ijk,0} + Y_{ijk,1} = 1) = \frac{\exp(\beta)}{1 + \exp(\beta)}$$

If people learned nothing from presentation, there is no effect of the presentation ($\beta = 0$). If people learned from the presentation, there is positive effect of the presentation ($\beta > 0$).

Evaluation Results

In total, 785 people attended my sessions and 411 people completed the IFAT cards for a 52% response rate. Audience members at these events were primarily farmers and male. For each question, participants answered more correctly in the post- than pre-test. For example, question 5 was answered correctly by 62% of participants on the pre-test; this increased to 89% on the posttest for a 42% increase. The greatest increase (77%) was observed for Question 3, with correct responses increasing from 52% to 92% between pretests and posttests.

By fitting the model using the survey data, the overall short-term learning effect was estimated as $\hat{\beta} = 1.46$, with standard error of 0.10. This value indicates that participants' changes in responses reveal a significant positive effect on the short-time learning from the presentation.

Summary

Looking forward, implementing program evaluation will continue to be an important focus for university extension personnel. Unfortunately, many universities around the United States have declining capacities, with fewer staff and reduced financial support

(Franz 2011). I wanted to provide immediate feedback to improve participant learning in my extension program in a novel way but had a limited extension evaluation budget. Therefore, I used a low budget, face-to-face technique and found out the following:

- Like traditional paper surveys, the IFAT cards are a unique tool to use in an extension setting, and were easy to score and quickly summarized. The format was highly flexible depending on the venue setup (e.g., outdoors or low-technology venues).
- Adults were receptive to immediate feedback to promote engaged learning, as indicated by a 52% response rate over 12 events.
- The use of the Rasch model was an effective way to describe the short-term learning effect comparing pretest and posttest evaluations.
- Close-ended evaluations provide reliable data about participant knowledge and behaviors; however, do not generate opinions and discussion like other survey tools.
- On a reduced budget, or in an extension event without the option for technology (e.g., internet, clickers, etc.), IFAT cards can provide reliable data.

Acknowledgments

I thank Chris DiFonzo (Michigan State University) for suggesting use of the IFAT cards; Matt O'Neal (Iowa State University) for facilitating one session and reviewing an earlier draft of this manuscript; and Zhulin He (Iowa State University) for assisting with statistical analysis.

References Cited

Caffarella, R. S., and S. Ratcliff Daffron. 2013. Planning programs for adult learners: a practical guide, 3rd ed. Jossey-Bass, San Francisco, CA.

Epstein, M. L., B. B. Epstein, and G. M. Brosvic. 2001. Immediate feedback during academic testing. Psychol. Rep. 88: 889–894.

Epstein, M. L., A. D. Lazarus, T. B. Calvano, K. A. Matthews, R. A. Hendel, B. B. Epstein, and G. M. Brosvic. 2002. Immediate feedback assessment technique promotes learning and corrects inaccurate first responses. Psychol. Rec. 52: 187–201.

Fink, A. 2017. How to conduct surveys: a step-by-step guide, 6th ed. SAGE, Los Angeles, CA.

Franz, N. K. 2011. Advancing the public value movement: sustaining extension during tough times. J. Extension. https://www.joe.org/joe/2011april/comm2.php.

Franz, N., M. Arnold, and S. Baughman. 2014. The role of evaluation in determining the public value of extension. J. Extension. https://www.joe.org/joe/2014august/comm3.php.

Hanson, A. A., J. Menger-Anderson, C. Silverstein, B. D. Potter, I. V. MacRae, E. W. Hodgson, and R. L. Koch. 2017. Evidence for soybean aphid (Hemiptera: Aphididae) resistance to pyrethroid insecticides. J. Econ. Entomol. doi:10.1093/jee/tox235.

Hodgson, E. W., B. P. McCornack, K. Tilmon, and J. J. Knodel. 2012. Management recommendations for soybean aphid (Hemiptera: Aphididae) in the United States. J. Integr. Pest. Manag. doi:10.1603/IPM11019.

Koch, R. L., B. D. Potter, P. A. Glogoza, E. W. Hodgson, C. H. Krupke, J. F. Tooker, C. D. DiFonzo, A. P. Michel, K. J. Tilmon, T. J. Prochaska, et al. 2016. Biology and economics of recommendations for insecticide-based management of soybean aphid. Plant. Health. Prog. 17: 265–269. doi:10.1094/PHP-RV-16–0061.

Ragsdale, D. W., B. P. McCornack, R. C. Venette, E. W. Hodgson, B. D. Potter, I. V. MacRae, M. E. O'Neal, K. D. Johnson, R. J. O'Neil, C. D. DiFonzo, et al. 2007. Economic threshold for soybean aphid (Hemiptera: Aphididae). J. Econ. Entomol. doi:10.1093/jee/100.4.1258.

Ragsdale, D. W., D. A. Landis, J. Brodeur, G. E. Heimpel, and N. Desneux. 2011. Ecology and management of the soybean aphid in North America. Annu. Rev. Entomol. 56: 375–399. doi:10.1146/annurev-ento-120709-144755.

Rasch, G. 1980. Probabilistic models for some intelligence and attainment tests. University of Chicago Press, Chicago, IL.

Song, F., S. M. Swinton, C. DiFonzo, M. O'Neal, and D. W. Ragsdale. 2006. Profitability analysis of soybean aphid control treatments in three north-central states. Staff Paper No. 2006–24. Michigan State University, Department of Agricultural Economics, East Lansing, MI.

Smith, M. F., L. Barber, and K. Walker. 1984. Practical benefits of evaluation: an example. J. Extension. https://www.joe.org/joe/1984january/a1.php.

Stup, R. 2003. Program evaluation: use it to demonstrate value to potential clients. J. Extension. https://www.joe.org/joe/2003august/comm1.php.

Taylor-Powell, E. 1998. Questionnaire design: asking questions with a purpose. Program Development and Evaluation G3658-2. University of Wisconsin-Extension Cooperative, Madison, WI. http://learningstore.uwex.edu/assets/pdfs/g3658-2.pdf.

Taylor-Powell, E., and C. Hermann. 2000. Collecting evaluation data: surveys. Program Development and Evaluation G3658-10. University of Wisconsin-Extension Cooperative, Madison, WI. https://learningstore.uwex.edu/Assets/pdfs/G3658-10.pdf.