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THE EFFECTS OF DELIVERY MODE UPON SURVEY RESPONSE RATE AND PERCEIVED ATTITUDES OF TEXAS AGRI-SCIENCE TEACHERS

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Abstract

Research was conducted to determine response rates and response reliability between three modes of survey techniques. Random samples of Texas Agri-Science teachers were surveyed using an e-mail instrument, a web-based instrument, and a traditional paper instrument. Responses among each mode were compared to determine if the mode of survey has an impact on the data collected. Response rates for each mode were also determined and compared. Researchers found that while there were no significant differences in reliability of responses, there were significant differences in response rates based on mode of collection. Traditional paper surveys yielded the high response rate at 60% with a significant drop to the web surveys at 43%, along with another significant decline to the e-mail surveys at 27%. The researchers propose a bi-modal method of data collection to minimize costs and time. Using data collected from this study, the researchers advocate a 25-day model of five individual contacts beginning with e-mail notifications of web surveys and concluding with follow-ups using traditional paper instruments. Further testing of this bi-modal survey model is encouraged. Other populations should be tested in order to add to the knowledge base in this increasingly important field.

Introduction/Theoretical Framework

The use of self-administered surveys is a vital tool for use by social science researchers. In agricultural education, surveys are used to understand perceptions, collect information, and gauge opinions. With the continuous increase in postal fees, coupled with the extensive time that it takes to transfer data from a paper survey to an electronic database, surveyors are beginning to turn to the World Wide Web to save both time and money. Electronic surveys have recently gained popularity as programs such as FrontPage© and websites such as http://www.Zoomerang.com have made the technical aspects of E-surveys a simple task. These E-surveys are appealing for the fact that they are inexpensive and require very little time to distribute or compile results when they are returned. In the academic arena, however, there has been very little research to verify that the demands of high response rates to control for non-response error are being met. Also, research has been limited in determining whether there is a significant difference in people who answer E-surveys versus those who answer traditional paper surveys. This study was designed to determine if E-surveys are a reliable means of collecting data from the given population and if there is a difference in response rates based on the mode of survey delivery.

Low return rate can be a problem with mailed surveys because of the effects of non-response error. Ayidiya and McClendon (1990) confirmed that a review of the literature reveals that, to date, an electronic method to consistently achieve response rates equal to those obtained with U.S. Mail surveys has not been developed." Heberlein and Baumgartner (1978) make a case that the defect in the mailed

questionnaire is not so much low response rates as a great variability in response rates across investigators, subject populations, questionnaires, and procedures.

Response rate and variability of e-mail and Web-based surveys has yet to be determined in the area of agricultural education. Ladner, Wingenbach, and Raven (2002) acknowledged that no research was found in agricultural education regarding the validity of any Internet protocols as a means of conducting social science research surveys.

The advantages of e-mail surveys outside of education are evident by the amount of research concerning the topic. Advantages include rapid surveying, less expensive due to lack of postage and printing cost, faster transmission, less likely to be ignored as junk mail, and more likely to be construed as environmentally friendly (Schaefer & Dillman, 1998; Yun & Trumbo, 2000). Kiesler and Sproull (1986) found in their study that there were fewer item-completion mistakes and fewer items were left blank on e-mail surveys as compared to mail. In 1998, Schaefer and Dillman reported on a research project using Washington State University faculty as the population. In this study, many positive attributes were revealed, including a response rate equal to the mail survey, respondents providing a more detailed response to open-ended questions, and many of the responses being returned more quickly, with 25% being returned within three days. The time for return rate is impressive in the e-mail survey, but it is still unknown whether people respond to questions differently by e-mail compared with other survey modes (Schaefer & Dillman, 1998).

Using a Web page as a means of collecting survey data is the least researched of the three modes. Dillman, Phelps, Tortora, Swift, Kohrell, and Berck (2001) reported that the newness of interactive voice response and Web survey methodologies are such that very little experimental research has been done, and the possible effects on survey measurement are mostly unknown. Dillman and Bowker (2001) alleged that we are witnessing an explosion in the use of Web surveys to collect sample survey information that was previously collected by other modes of surveying.

The advantages of using Web surveys are basically the same as e-mail surveys. Dillman and Bowker (2001) reported that Web surveys would still retain significant advantages such as speed, the elimination of postage and stationary costs, and low processing costs. Using the Web also allows researchers to utilize complex question formats and skip patterns, which are unavailable in the e-mail format (Schaefer & Dillman, 1998).

Since Web surveys are so new, there are many problems that remain to be resolved. Dillman, Tortora, and Bowker (1998) listed the disadvantages of Web surveys as variation in computer literacy, processing power of computers, screen configurations, connection speeds, and individual's access to computers. The consistency between what the Web designer intends and what the participant actually sees has not been established.

Fraze (2001) reported in a study of technology adoption by Texas agri-science teachers that questionnaires were the least supported of the on-line activities, but further study should be conducted to compare the return rates of on-line and instruments delivered via alternative methods. A recent survey reported that nearly all public school teachers have access to computers at school (U.S. Department of Commerce, 2000). The number of agri-science teachers in Texas who list an e-mail address in the *Directory of Texas Teachers of Agricultural Science and Technology* has steadily increased over the past few years, from 6.5% in 1998 to 65.9% in 2001 (Fraze, 2001).

The review of literature revealed that if the population is willing to adopt the e-mail or Web survey, a tremendous savings could be accrued in money and time. It was also found that among many populations the same response rate could be achieved using the mail, e-mail, and Web survey modes, but it has not been determined if respondents answer the survey questions with the same answer on different modes (Schaefer & Dillman, 1998; Dillman et al., 2001).

Purpose and Objectives

The purpose of this study was to evaluate Texas agri-science teachers' responses to different data collection modes. The following null hypotheses were developed in order to accomplish the purpose of this study:

1. There will be no significant difference in response rate based on mode of data collection.
2. There will be no significant differences in days to respond based on mode of data collection.
3. There will be no significant difference between the response rate and selected demographic variables including age, teaching experience, gender, education, size of school, FFA area, and number of teachers in agri-science department.
4. There will be no significant difference in respondents' answers based on the mode of data collection.

Methodology

The researchers utilized an experimental posttest-only control-group design survey for this descriptive correlational study to determine relationships among variables. Survey research allows the researchers to use instruments to gather data from a sample in order to measure their attitudes and opinions toward some issue (Ary, Jacobs, & Razavieh, 1996).

The target population for this study encompassed all secondary agricultural science instructors in Texas for the 2001-02 school year, who listed their e-mail address in the *2001-2002 Directory of Texas Teachers of Agricultural Science and Technology* (N = 1,014) (Texas Education Agency, 2001). A systematic random sample (n = 285) was selected (Krejcie & Morgan, 1970) according to the population size. Three comparison groups (n = 95) were randomly assigned from the sample. One hundred twenty-four teachers responded to the survey, for a return rate of 43.51%.

Dillman's (2000) Tailored Design Method was used to guide this study. Table 1 outlines the timeline, which may vary with the population that is to be sampled. The novelty of e-mail and Web surveys inhibits the comprehensiveness of research on the effects of survey modes.

Table 1
Timeline of Mail-outs: Based on Dillman's (2000) Tailored Design Method

Week	Procedure
Week One	Pre-notice Letter
Week Two	Questionnaire Mail-out
Week Three	Postcard Thank you/Reminder
Week Four	Replacement Questionnaire
Week Five	Invoking Special Procedures

The instrument used was a questionnaire entitled "Leadership Education in Agriculture" designed by the researchers. The purpose of the questionnaire was to determine Texas agri-science teachers' view on leadership in the classroom. The questionnaire was composed in a three-part booklet format that included 37 Likert-type questions, seven demographic information, and two open-ended questions. When the questionnaires were returned, the results were manually entered into a Microsoft Excel spreadsheet.

The e-mail survey was formatted in plain text with the subject line reading Leadership Education. The e-mail began with a brief letter explaining the survey. The letter was followed by instructions. The instructions read "touch 'reply' button, respond to questions, touch 'send' button." The survey was typed exactly like the mailed survey. Each e-mail was sent individually so the recipient did not know who else was receiving the survey. When the surveys were returned, the data were imported into a Microsoft Excel spreadsheet.

The Web survey mirrored the appearance of both the mail and e-mail survey. The survey was created using Front Page 2002. The survey utilized radio buttons to answer the Likert-type questions. Blank form fields were used to answer demographic and open-ended questions. The participants were notified of the survey with an e-mail that included a link to the website. In case the link did not work properly, the e-mail included the URL that could be typed manually. After completing the survey, the participant clicked on a submit button, which automatically sent the data to the researchers' e-mail. The results were imported into the Microsoft Excel spreadsheet.

Measurement error was controlled by establishing face and content validity through field-testing. The field test sample (n = 36) consisted of Texas agri-science teachers in the target population, but not included in the sample. The participants received a cover letter, questionnaire, and self-addressed envelope. Both teaching criteria and depth of coverage were assessed for 37 knowledge and skill categories related to leadership education. Teaching criteria was measured using a scale ranging from "1=Not Important" to "4=Very Important." Depth that each criterion was covered was measured using a scale ranging from "1=Not Covered" to "4=Covered in Depth." Using SPSS 10.0 software, the instrument was found to be reliable based upon Cronbach's alpha of .89 for teaching coverage and .78 for depth of coverage.

The data collection procedure followed the Dillman (2000) Tailored Design Method for delivery by mail, e-mail, and Internet questionnaire administration. The mail group received all correspondence by mail. The e-mail group received all correspondence by e-mail, the Web group received correspondence through e-mail, and the survey was posted on a Web site. Data collection took place during the spring 2002 semester (see Table 2).

Table 2
Contact Methods and Timing

Method of Contact	Date of Contact
Pre-notice Letter	January 23, 2002
Questionnaire	January 30, 2002
Reminder/Thank You Cards	February 6, 2002
Replacement Questionnaires	February 13, 2002

Data were analyzed using a statistical software program, SPSS/PC for Windows, Version 10.0. To permit statistical treatment of the data, numerical values were assigned to categories, thus permitting means and standard deviations to be calculated. Frequencies and means were used to report survey response rate.

To assess the initial hypotheses, percentage of response for each of the three modes were used as dependent variables in conjunction with the independent variable mode (US mail, E-mail, or Web). Although the researchers acknowledge concern for inflating the overall alpha level using multiple independent t-tests, it was decided that this was an appropriate analysis. A t-test was used to determine if there would be a significant difference in response rate based on mode of data collection. The test reveals whether or not there was a statistical significance between the Web group to mailed group, e-mail group to mailed group, and e-mail group to Web group. A p value of equal or less than .05 was deemed statistically significant.

Analysis of variance was used to analyze the second hypothesis. A post hoc test was used to determine if there was a significant difference in days to respond based on mode of data collection. The test measured variances between sample groups' responses. A "Gabriel" statistic, which is a multiple comparison and range test, was used to compare U.S. mail to e-mail, U.S. mail to Web, and e-mail to Web.

To test the third hypothesis, the researchers utilized descriptive statistics to determine differences in the selected demographic and program-related variables to mode of delivery. Frequencies and means were calculated to derive demographic information such as FFA area, size of school, level of education, and gender. Descriptive statistics were used to summarize the data pertaining to age, number of teachers in agri-science departments, and years of teaching experience. To assess the final hypothesis, ANOVA was utilized to determine if actual responses differed based upon mode.

Results and Findings

Hypothesis one stated there would be no significant difference in response rate based on mode of data collection. Three experimental groups were randomly selected from the population of Texas agri-science teachers who provided their e-mail address in the *2001-2002 Texas Teachers of Agricultural Sciences & Technology Directory* (Texas Education Agency, 2001). Each experimental group contained 95 participants. The response rates are summarized in Table 3.

Table 3
Summary of Response Rate Based on Mode of Data Collection

Mode	*N*	*f*	*%*
Mail	95	57	60.0
E-mail	95	26	27.37
Web	95	41	43.16
Total	285	124	43.51

The findings showed a significant difference between Web response rate and mail response rate (p = .001). There is also a significant difference between e-mail response rate and mail response rate (p <.001). The e-mail response rate versus the Web response rate was significantly different (p = .005). Table 4 summarizes the comparisons of the three experimental groups based on mode of data collection.

Table 4
Paired Comparison of Web Response Rate Based on Delivery Mode

Group	*n*	*M*	*SD*	*t*	*P*
Web Response Rate	41	.432	.50	-3.297	.001*
Mailed Response Rate	57	.600	.49		
E-mail Response Rate	26	.295	.46	-6.492	.001*
Mailed Response Rate	57	.600	.49		
E-mail Response Rate	26	.295	.46	-2.908	.005*
Web Response Rate	41	.432	.50		

*p < .05

Hypothesis two stated there would be no significant difference in days to respond based on mode of data collection. Table 5 summarizes the influence of mode of data collection on the number of days to respond. Although the data were analyzed in whole numbers (days to respond), to illustrate the speed of response, the first survey was returned from the mail group five days after the surveys were sent and the last one was received on day 47 of the collection period. The first e-mail survey was returned three hours and 10 minutes after it was sent and the last survey arrived 22 days later. The first Web survey was returned within 15 minutes of delivery and the last arrived 31 days later. The e-mail and web groups' response time was not significantly different (p = .77). The e-mail group's mean days to respond was 7.3, while the Web group's mean was 9.1 days. The results showed that there was a significant difference between the days to respond for the mail group and the e-mail group (p = <.001) and the mail and Web groups (p = .001). The mail group had a mean response time of 15.6 days.

Table 5
The Influence of Mode of Data Collection on Number of Days to Respond

	Mail	E-mail	Web
N	57	26	41
M	15.6[a]	7.3[b]	9.1[b]
SD	9.24	6.67	8.34

Source	*df*	*ss*	*ms*	*F*	p
Between Groups	2	1634.30	817.15	11.40	<.001
Within Groups	121	8672.38	71.67		
Total	123	10306.68			

[1] Means whose letters are different are significant at .05 based upon Gabriel's post hoc analysis

Hypothesis three stated there would be no significant difference between the response rate and selected demographic variables including age, teaching experience, gender, and education. No significant differences were found in any of the categories.

Hypothesis four stated there would be no significant difference in response based on the mode of data collection. All the questions on the survey were grouped into specific constructs. The answers to each construct were analyzed for both parts of the dichotomous questions. The parts included ranking the importance of each construct and the depth of coverage of each construct. The researchers did not expect to find a difference in the responses from one survey mode to another. Therefore, this needed to be examined to ensure that using a different mode would not affect the results. There were no significant differences in the answers to the constructs with the exception of one, the depth of coverage of career development skills showed a significant difference ($p = .02$). The researchers found no explanation as to why this construct had a significant difference.

Conclusions and Recommendations

The study found that Texas agri-science teachers were willing to respond to surveys that require using computer technology, but the response rate was higher using the traditional mailed survey. No differences were found among demographic variables that would attribute to a difference in response rate.

The survey by U.S. mail had the highest response rate at 60%. This mode had both positive and negative aspects. The teachers were familiar with the process of filling out the survey and returning it to the researchers. For the most part, the surveys were filled out correctly with very few questions left blank. The negative aspects include time and cost. The first survey was returned five days after the survey was mailed and the last one arrived on day 47 of collection. The number of mail surveys returned each day was more balanced than the two electronic groups. The data from the mail surveys were also time consuming to analyze, because they had to be manually entered into a spreadsheet. The cost of using mail surveys was significant when

compared to e-mail or Web. The estimated cost for sending materials to 95 people was $300. The costs included postage, envelopes, and printing.

The e-mail group had the lowest response rate with only 27.37%. The e-mail survey was the most problematic of the three modes. The first challenge was creating an instrument that could be universal to all browsers, e-mail programs, and computer platforms. In many instances, the recipient would receive a survey that was difficult to comprehend because the original formatting was lost. This was also a problem when receiving the results from the participants, because it was difficult to distinguish which column was marked if the formatting had been altered.

The e-mail was sent as a plain text document, which solved many of the formatting problems, but it was not a perfect solution. A few of the participants were unable to receive a survey because their e-mail address was incorrect or their mailbox was full, resulting in a failed delivery. Some of the participants had questions regarding the directions, because this was a new process they had not been exposed to previously.

The e-mail survey is cost efficient and the response time was positive. The only cost associated with creating or sending the e-mail survey is labor. Most of the surveys were returned within two days of each contact. Very few surveys were received from a contact after the third day.

The e-mail surveys were returned with many questions unanswered. Several participants only answered one column of questions, which might have been a result of formatting problems. Many participants also left the demographic information blank. Only two demographic questions were left blank by respondents from the other experimental groups, while 15 questions were left blank on the e-mail survey. The number of questions left blank indicates that the participants had difficulty filling out the survey.

From a research perspective, the Web survey was the best mode to use for a survey. The participants did not seem to have difficulties filling out the survey. The survey used radio buttons that included a feature that only one box could be selected per question. If a respondent wanted to change his or her answer, the only requirement was to enter another selection. The surveys were returned with a high completion rate. Similar to the e-mail survey, labor was the only cost associated with sending the survey. The surveys were returned in a timely fashion. If the surveys had not been returned in three days from contact, it was likely it would not be returned. The Web surveys were automatically sent to the researchers' e-mail address when the participant clicked on the submit button at the end of the survey. Entering the data into a spreadsheet was simple when the data could be directly imported.

Problems with the Web survey mode were similar to those encountered with the e-mail survey. The negatives included that it did not receive the highest response rate, only 43.2%. Also, the researchers must know how to use Front Page© or other Web page programs in order to create the survey. It was also difficult to determine how many teachers received the e-mail and actually went to the website to open the survey. Some of the addresses were incorrect in the directory and two mailboxes were full.

The overall response rate was 43.5%, which was low when compared with other studies using this population. The low response rate is attributed to the time of year the data collection occurred. The researchers chose to conduct this study at a time that most Texas agri-science teachers consider their busiest time of the year, the stock show season that lasts from January through March.

Hypothesis one stated there would be no significant difference in the response rate based on mode of data collection. The null hypothesis was rejected due to finding a significant difference between each mode of data collection. The researchers attribute this difference to a few factors. The mail survey received a higher response rate due to the fact most agri-science teachers are accustomed to receiving paper surveys and understand the process of returning the survey. The e-mail achieved the fewest respondents due to the unfamiliar formatting that was difficult for many participants to

use. The Web survey was more user friendly than the e-mail survey resulting in a higher response rate. The Web and e-mail survey required teachers to have adopted computer technology, which was reflected in the lower response rate when compared to the mail survey.

The second hypothesis stated there would be no significant differences in days to respond based upon mode of data collection. The second null hypothesis was rejected after finding a significant difference in the days to respond between the mail survey and the other two modes of surveys. The mail survey would require more days to respond since it must go through the postal service. E-mail can be sent and responded to in a matter of minutes, whereas mail takes days. The mail surveys arrived at a steady pace throughout the study, but the e-mail and Web surveys arrived in clumps immediately following contact days. Each group received the survey plus two additional contacts. The contacts were exactly one week apart. The majority of e-mail and Web surveys would arrive within two days following a contact.

Hypothesis three stated there would be no significant difference between the response rate and selected demographic variables including age, teaching experience, gender, and education. This study found no significant differences between the variables so the researchers failed to reject this hypothesis. The researchers looked at age to see if it might be a factor that would affect response rate. Logically, younger teachers would be more likely to use e-mail and the Internet because younger people tend to be more willing to adopt technology. The study found age did not have an effect on response rate. Each experimental group had basically the same range, between 23 and 57 years of age. This may be credited to the increased use of the Internet in the school setting. For example, agri-science teachers are now required to enter some FFA contests online.

Teaching experience was examined to determine if it had an impact on response rate. The reasoning behind this question is teachers with less experience are more likely to have recently been enrolled in college courses that would have required knowledge of e-mail and the Internet. The study found years of teaching experience did not affect response rate. All three experimental groups had similar ranges of 1 to 34 years of teaching experience. The means ranged from 12.63 to 15.96 years.

The majority of respondents in all three experimental groups were male (82.5%). This follows the population of Texas agri-science teachers in that the majority of teachers are men (89.92%). The level of education was also examined to determine if attaining a certain level of education made teachers more inclined to respond to a survey. The study found there is no reason to believe a certain level of education will increase the likelihood of a teacher responding to a survey.

Hypothesis four stated there would be no significant difference in response based on the mode of data collection. In future studies, the researchers should examine the validity by comparing the Web-based surveys to the mail surveys similar to comparing early and late respondents.

The study provided new information regarding Texas Agri-Science teachers' attitudes towards responding to different modes of surveys. Results of the study may be of use to future researchers. Based upon the results, several recommendations can be made.

1. Web surveys may be used as a research tool for the population examined in this study. Directory providers should accumulate a more extensive list of e-mail addresses. The addresses should be verified for accuracy and updated annually.
2. The researchers warns against using an e-mail survey. With the availability of Web surveys, an e-mail survey is outdated. The features of the Web survey make it a better mode for self-administered surveys.
3. Researchers should be encouraged to incorporate computer technology into their surveys. A contact strategy that may be ideal for self-administered surveying would incorporate features of the Web and traditional mail survey. The

researchers recommends using a five-contact strategy. This five-contact strategy requires 25 days to complete. Table 6 summarizes the proposed method for mixed-mode surveys.

Table 6
Summary of Proposed Method for Mixed-Mode Surveys

Contact	Day	Method	Mode
1	1	Pre-notice Letter	E-mail
2	4	Survey Packet	E-mail/Web
3	7	Thank-you/reminder	E-mail
4	11	Survey Packet	U.S. Mail
5	15	Thank-you/reminder	E-mail

Further studies should be completed on different populations to determine if the same outcome will result. The results of this study can only be used to describe the population of Texas agri-science teachers.

Further research is also recommended into the use of mixed mode surveys. Researchers should continue to examine how to obtain the highest response rate to self-administered questionnaires while controlling cost and limiting the amount of time of data collection. More studies should also be conducted to ensure the validity and reliability is the same across all modes of data collection.

The contact strategy suggested in the recommendations of this study should be tested to determine if a higher response rate is achieved at a lower cost. Possible populations that could be surveyed using this contact strategy include Extension agents, professional organizations, and college students.

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