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Abstract:

The purpose of this study was to determine whether or not survey medium (electronic versus paper format) has a significant effect on the results achieved. To compare survey media, responses from elementary students to British Columbia's Satisfaction Survey were analyzed. Although this study was not experimental in design, the data set served as a rich source from which to investigate the research question. The methods included reliability, item mean, response rate, response completeness, and factor analysis comparisons across survey media. From the analyses, the differences between electronic and paper media in this study appear to be minor, and do not seem to have a significant effect on overall results. In conclusion, the medium does not seem to overly affect response patterns and does not pose any threats to the validity or reliability of survey results.

Does Survey Medium Affect Responses? An Exploration of Electronic and Paper Surveying in British Columbia Schools

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Introduction

The British Columbia (BC) Ministry of Education introduced its Provincial Satisfaction Survey in the 2001/02 school year. It was developed “as part of ongoing efforts to make the education system more accountable, and to increase the existing information that districts and schools use to evaluate and improve their performance” (British Columbia Ministry of Education, 2004). The survey measures student, parent, and staff satisfaction with areas such as achievement, human and social development, and safety. The BC Ministry of Education has been utilizing electronic surveying for its annual survey of student, staff, and parent satisfaction since the 2002/2003 school year. The move toward electronic surveying has been gradual, as each school district must assess their ability to manage an electronic survey, as must each school within those districts. However, in 2004, a sufficiently large number of schools in British Columbia administered the survey in its electronic format to allow for comparisons between media. Researchers at the BC Ministry of Education have turned to the question of whether or not survey medium (electronic versus paper format) has a significant effect on the results achieved. By examining the effects of survey medium on responses, evidence of the validity of electronic surveying in comparison to traditional methods can be accumulated.

Literature Review

Survey research methodology has been greatly affected by the advent of new computer technologies over the last thirty years (Dillman, 2000). One such technology is, of course, the Internet. The development and expansion of the Internet has created new possibilities for researchers; for instance, it is a new forum for survey administration. Surveys can now be completed online or via email. Similarly, new survey populations can be accessed very simply, as the Internet is available worldwide.

Using the Internet in surveying has proven to be cost-effective as well (Moss & Hendry, 2002; see also Solomon, 2001; Dillman, 2000). Printing and shipping costs do not exist as they do for mail-in surveys and Internet surveying is not as labour-intensive as in-person or telephone surveys. In fact, once the survey is designed and posted to the Internet (or prepared for email delivery), very little effort is required to deliver it.

Electronic surveying does not appear to represent a significant burden to respondents; in fact, a study in which participants filled out both a printed survey and an online one “found little difference in time or effort between the two surveys” (Kaye & Johnson, 1999, p. 325). Lastly, using the Internet has implications for the return and analysis of data once the surveying is finished. In particular, using electronic surveys eliminates the need to scan individual surveys or “the often error prone and tedious task of data entry” (Solomon, 2001, Introduction).

However, researchers in all fields are still wary about the use of Internet technologies in surveying. In particular, there are concerns that the medium itself may create a bias in responses that would not exist in paper-and-pencil or telephone surveys (Nesbary, 2000). The results of research involving electronic surveying have been mixed. For instance, when considering the issue of whether survey medium affected response rates, some researchers report that electronic surveys garnered more responses, while others found that the opposite was true (Moss & Hendry, 2002).

There is a similar concern that the type of survey method used will affect the validity of the data collected. Researchers report that survey data collected online appears to have less missing or nonsensical data than paper-and-pencil surveys do (Nesbary, 2000). This suggests that in some ways, electronic surveying represents an improvement over more traditional methods. However, respondents may approach the two media quite differently, and this can have an effect on the validity of data. Some researchers have found that electronic surveys garner more detailed and longer comments in open-ended questions, speculating that “respondents may be more likely to be self-disclosing or less likely to respond in a socially desirable way because of the sense of distance associated with responding

on the Internet” (Daley, McDermott, Brown, & Kittleson, 2003, p. 117). However, others have noted that respondents tend to read things that are online more quickly, suggesting that they take less time to consider questions as they complete a survey (Crawford, Couper, & Lamias, 2001).

As well, certain questions may be more sensitive to the effects of different modes of administration than others. In their study of college student engagement, Carini, Hayek, Kuh, Kennedy, and Ouimet (2003) found while little difference between electronic and paper media existed on most scales, there was one notable exception. This was with regard to the scale on computing and information technology, on which a substantial difference was found between the two modes, with web survey participants showing more favorable responses (see also Webster & Compeau, 1996).

Finally, there are practical concerns to consider. A traditional paper survey will look the same regardless of who is looking at it. Electronic surveys, however, may change in appearance depending on the respondent’s computer settings (Dillman, 2000). For example, questions that fit across the screen of one computer may disappear off the edge of another. Similarly, while a survey may have been designed so that the text and background colors contrast with each other (for instance, black text on a white screen), some computer settings may display these colors differently, making the survey more difficult to read (Kaye & Johnson, 1999). Differences in technology are also important; users with older computers may not be able to properly display surveys that are web-based (Dillman, 2000).

Thus, it appears that there is the potential for differences to arise on paper versus electronic survey methods. However, there are many factors that must be considered in trying to determine whether these differences actually influence the results. In order to explore the question of whether survey medium has an effect on survey response, this study examines responses to the BC Provincial Satisfaction Survey.

Research Question

In this article, we are concerned with the issue of whether or not introducing a different survey medium has any significant effects on results. Because paper and web-based surveys are occurring simultaneously in the BC education system, this provides a natural experiment of survey modes for study. The survey is a census survey of all students in grades 4¹, 7, 10, and 12, their parents, and school staff, including over 400,000 potential respondents. However, in order to ensure that the administration process of the survey was equivalent, only those surveys administered to elementary students (who received more detailed instructions, regardless of the survey medium) are included in this study. Thus, this study is in contrast with much of the research that has been conducted thus far: first of all, its target population is children, not adults. As well, the overall population for the Satisfaction Survey is identifiable, which is unusual, especially for electronic surveys.

The question of focus for this study, therefore, is what differences exist in response tendencies between paper and electronic survey methods? The next section describes the methods by which we have approached this question.

Methods

Equivalence of Forms


In order to ensure that the two survey media were equivalent, the researchers first examined each instrument and compared the process of administering and analyzing the survey to eliminate the possibility that procedural differences could account for any differences found in the survey results. Differences and similarities are explained in this section so that the analysis can be interpreted in the proper context.

Survey Design


Paper Survey

The Satisfaction Survey consists of between 19–27 questions depending on the target group. While several questions are of a yes/no nature, the majority of questions utilize a 5-point likert-style response scale. In order to minimize the amount of time required, the surveys were kept short in length and required fewer than 20 minutes to complete. Each school determined the best way to administer the surveys within the set time frame. Figure 1 is an excerpt from the grade 4 paper-based survey.

Figure 1: Layout of Paper Survey


 Ministry of Education
 School Name: _____
City: _____ School District: _____

2004 STUDENT SURVEY – GRADE 4

Instructions:					
• With a pencil (do not use ink), fill in the circle that matches your answer.					
• If you make a mistake, please erase it completely and fill in the correct circle.					
1. Do you like school?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Do you like what you are learning at school?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Do you try to do your best at school?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Do adults in the school treat all students fairly?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Do your teachers help you with your schoolwork when you need it?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. At school, are you learning about healthy food and exercise?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Electronic Survey

Electronic surveys were designed to appear similar to the paper survey. However, because of the change in medium, there are some features that are different. For instance, electronic surveys require the use of a unique logon number to access the survey. The survey questions are separated into different screens, displaying four to five questions at a time. Respondents are asked to select their answers using a radio button. Responses can be changed but only one response can be selected at a time for any individual question. Like the paper survey, questions can be left blank. Respondents use a “next” button to progress through the survey screens. An indicator of progress through the survey is also provided in the lower left corner (e.g., “viewing questions 1–5 of 21”). Dillman (2000) provides an extensive list of web-based survey design principles. For example, he suggests that each question should be presented in a conventional format similar to that normally used on paper self-administered questionnaires; logon numbers should be provided for limiting access only to people in the sample; respondents should not be required to provide an answer to each question before being allowed to answer any subsequent ones; and the use of graphical symbols or words that convey a sense of where the respondent is in the completion process should be utilized.

The BC Satisfaction Survey meets the majority of these principles². Figure 2 is an excerpt from the grade 4 electronic-based survey.

Figure 2: Layout of the Electronic Survey

2004 Student Survey - Grade 4

• Please read the questions below
• Please click the circle that matches your answer

	All of the Time	Many Times	Some-times	Few Times	At No Time
1. Do you like school?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Do you like what you are learning at school?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Do you try to do your best at school?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Do adults in the school treat all students fairly?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Do your teachers help you with your schoolwork when you need it?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Viewing Questions 1-5 of 19

Survey Process

Table 1 compares the similarities and differences in the process and appearance, by survey type. Our interest here is in how these differences in process and appearance may affect the results achieved. The table is broken out into stages of the survey process (*distribution, administration, appearance/performance, responses, and the resulting data file*).

Table 1: Comparison of the Survey Process, Paper and Electronic Media

Survey Process	Paper	Electronic
Distribution	<ul style="list-style-type: none"> • Printing/addressing, shipping & mailing errors may occur • Photocopying of forms is possible • Corruption of forms (e.g. trading between schools, photocopy size and reflectivity, wrinkling, soiling) • Missing forms in the mail 	<ul style="list-style-type: none"> • Logon numbers and the website address sent by email to school administrators • Logon numbers can be mixed up among grades or across schools • Extra logon numbers are sometimes needed
Administration	<ul style="list-style-type: none"> • Schools are expected to distribute paper surveys • A script is provided to the administrator • Paper surveys must be collected and returned 	<ul style="list-style-type: none"> • Schools expected to distribute Logon Numbers, provide computer access, and direct students to the website • Internet access is necessary • A script is provided to the administrator • Students must be brought to a computer lab to complete the survey
Appearance/Performance	<ul style="list-style-type: none"> • Single sheet of paper • Respondents fill in "bubbles" with a pencil to indicate their response • Completion is slower than electronic 	<ul style="list-style-type: none"> • Multiple screens • Respondents select responses by clicking the mouse over a radio button • Completion is faster than paper • An indicator of progress through survey is provided
Responses	<ul style="list-style-type: none"> • No "rules" for data capture (e.g. respondents can fill in two circles, or mark half way between circles, etc.) • Corruption of forms (e.g. changing question wording or response scales) is possible • Notes on surveys (e.g. doodles, names, comments) are hard to capture or use 	<ul style="list-style-type: none"> • "Rules" for data capture are possible (e.g. no double responses, no comments, no doodling etc.) • Corruption of forms not possible • Capture of comments can be accommodated for school use • Additional District and School questions can be added at end
Data File	<ul style="list-style-type: none"> • Scan to data file • Mis-scanning (due to form corruption) can occur • Hand entry required where form corruption prevents scanning (increases error) 	<ul style="list-style-type: none"> • Direct to data file (no scan) • Limited error introduced

Sample

For the purposes of this research, we chose to limit our sample to the 2003/04 school year. An examination of the survey process made it evident that the methods of administration of paper and electronic surveys were most closely matched for student surveys. In order to reduce the potentially misleading effects of survey administration³, we have therefore limited our sample to younger student respondents. Students in grades 3/4 and 7 are thus included in the sample¹. We also chose to limit our sample to only those schools that conducted all their student surveys electronically or all of them by paper rather than those schools who used a mix of media. Finally, we selected standard schools for our sample, as participation by non-standard schools⁴ was optional and participation rates were therefore often much lower for non-standard schools.

In the end, we had a sample of 66,683 student responses from 1,216 individual schools. Table 2 shows the number of schools and the number of respondents by grade and survey type.

Table 2: Number of Schools and Respondents by Grade and Survey Medium

Grade	Medium	Number of Schools	Number of Respondents
Grade 3/4	Electronic	666	23,473
	Paper	452	15,568
	Total	1,118	39,041
Grade 7	Electronic	416	15,052
	Paper	347	12,590
	Total	763	27,642

Note: Due to the fact that some schools enroll both grades 3/4 and 7, the sum of schools in this table (1,881) is greater than the total number of schools included in the sample (1,216).

Variables

Our main goal was to examine whether survey type (paper vs. electronic) would have an effect on survey responses. Additionally, however, there were other factors that we needed to consider in order to ensure that the effects we observed were, in fact, due to the survey medium. In particular, we hypothesized that the effect of survey type might be mediated by the age of the respondent; thus, the child's grade is important to consider. Our analysis, therefore, treats grade 3/4 students and grade 7 students as separate respondent groups.

In order to determine whether or not survey medium was affecting response rates, we chose to focus on five indicators. First, we felt that examining survey reliability would be important. Secondly, we looked at whether there were significant differences in the item means between survey types. We looked at response rates across survey medium, and we considered whether the type of survey used had an effect on overall response completeness (i.e., the number of missing values in a given survey response and patterns of missing response). We also conducted a factor analysis of each survey medium to see if there were any major differences in the way that individual items loaded, as a possible indication of different response patterns for each survey medium. We felt that these indicators were comprehensive and would allow us to comment with some certainty on our research question.

Procedures

Sample Comparison

Before we could compare the survey instruments, it was important to determine whether the students who filled out paper surveys were sufficiently similar to those who filled out electronic surveys. This was necessary so that we could eliminate respondent differences as a possible explanation for any differences we might find between the two media. To determine if the samples were similar, we examined the proportion of boys and girls, proportion of Aboriginal and Non-Aboriginal students, the region in which respondents filled out the survey, and the average class size for both paper and electronic surveys. These variables represented the only demographic data available to us, as the survey was administered anonymously.

Reliabilities

Using SPSS version 10.0, an internal consistency reliability analysis (Cronbach's alpha) was conducted to determine the interrelatedness of the survey questions. The internal consistency reliability is an index of the extent to which the questions "hold together" in the sense that if one responds in one way to say question 1, then one would tend to respond similarly to other questions on the survey. This index can vary from a minimum of 0.0 to a maximum of 1.0. An alpha approaching 1.0 suggests that the questions comprising a survey do have high internal consistency.

Item Means

Overall item means for each instrument were calculated, as were means for each individual question on the surveys. Using a t-test, means for each question were compared to determine whether there was a significant difference between electronic and paper media. Such information assists an analysis of differences between the two media by providing an indication of whether respondents exposed to a particular medium responded to particular questions differently than those using the other medium.

Completing multiple tests on a single sample can affect the likelihood of finding a relationship that is due to more than chance. Abdi (2007) explains:

The more tests we perform on a set of data, the more likely we are to reject the null hypothesis when it is true...this is a consequence of the logic of hypothesis testing: we reject the null hypothesis if we witness a rare event. But the larger the number of tests, the easier it is to find rare events and therefore the easier it is to make the mistake of thinking that there is an effect when there is none (p.1).

In order to address this possibility, one strategy is to use the Bonferroni correction, which adjusts alpha according to the number of tests conducted on one sample. While not the only method of adjusting for multiple tests, it is a generally accepted method that is relatively simple to carry out. The Bonferroni correction was used for item mean calculations, using the number of questions on each survey instrument as the denominator. In the Results section below, the adjusted alpha is reported along with the results of the *t*-tests.

Response Rates

The response rates by grade for each group of schools (paper and electronic) within our sample were calculated by taking the total number of survey responses received and dividing it by the number of surveys intended for that population.

Patterns of Missing Response

As well, patterns of missing response were examined. First, the average number of missing cases was calculated for each survey medium, to determine whether respondents to one medium were more likely to miss answering questions than another. Secondly, 2×2 contingency tables of missing vs. non-missing response were compared between survey medium for each question, allowing us to explore whether a definite pattern exists for either medium, and determine any differences in patterns of missing response between media. This provides an indication of the extent to which survey medium affects respondent error.

Factor Analysis

Finally, we conducted a comparison of factor patterns between the two survey media. Factor analysis is used to identify a small number of factors that can represent relationships among sets of many interrelated variables. It is based on correlations between responses to individual variables (i.e., survey questions) and is used to identify one or more linear combination of variables that collectively explain as much of the co-variation among a set of variables as possible. In this paper, factor analysis is used to compare differences in patterns of response between the two survey media (paper or electronic). The data were separated into groups by grade and survey medium, and separate factor analyses were run for each sub-set of data. For each grade group, the component matrix was then examined for how similarly each individual question loaded into each factor. The number of factors extracted and the total variance explained were also examined.

Exploratory factor analysis was used in this analysis. While we acknowledge that traditionally, confirmatory factor analysis (CFA) is the more common method of comparing invariance between two groups, we did not feel that we had a strong enough theoretical explanation for multiple factors (i.e. those that go beyond the concept of ‘satisfaction’) to warrant using CFA. Instead, we used a Procrustean rotation that allows for the factor matrix of one group to a ‘best fit’ structure of the second group to compare the two structures analytically. This method involves calculating cosines among factors; these can then be used to rotate one matrix to its best-fit position with a target matrix. The resulting cosine correlations indicate whether the factors are invariant across the two groups (see Thompson, 2004 for a more detailed explanation of the use of Procrustean rotation to measure invariance).

Findings

Sample Comparison

The sample selected for this research shows almost equal proportions between the electronic and paper surveys for boys and girls. The proportions of Aboriginal and non-Aboriginal respondents are also very similar. There is some difference in the proportions of electronic surveys to paper surveys by region. When differences in school size were examined for electronic and paper surveys, it was found that the distributions of size were very similar. Table 3 provides a comparison of sample characteristics by survey medium.

Table 3: Reliability Measures for Achievement Scales

Demographic		Electronic	Paper
Gender	Boy	50.36%	50.77%
	Girl	48.45%	48.89%
	Unspecified	1.18%	0.34%
Region	Lower Mainland ^a	48.83%	51.17%
	Other	66.73%	33.27%
Aboriginal Status	Aboriginal	12.68%	11.31%
	Non-Aboriginal	85.62%	87.02%
	Unspecified	1.70%	1.67%

^a "Lower Mainland" refers to the most densely populated urban area of British Columbia, located in the southwest of the province. It comprises 15 separate school districts that serve this metropolitan area.

The average school size for schools that administered the survey electronically was 73 students, compared to 71 students for paper-based administration.

Reliabilities

The grade 3/4 internal consistency reliability measure for the electronic survey was .76 and .75 for the paper survey. The grade 7 internal consistency reliability measure for the electronic survey was .84 and .81 for the paper survey. Table 4 provides the internal consistency reliability of each medium by grade.

Table 4: Reliability Measure by Survey Medium for Grade 3/4 and Grade 7 Students

Survey Medium	Number of Items	Number of Cases	Alpha
Grade 3/4 Students			
Electronic	17	21,782	.76
Paper	17	14,054	.75
Grade 7 Students			
Electronic	18	24,256	.84
Paper	18	13,328	.81

Item Mean Comparisons

The average mean response on a 1–5 likert-type scale for the paper surveys administered to grade 3/4s was 4.16, while the average mean for the electronic surveys administered to these grades was 4.10. The average mean for the paper surveys administered to grade 7s (3.84) was almost identical to the electronic surveys administered to this grade (3.83).

In addition to overall means, item by item mean comparisons were also conducted. As mentioned in the Methods section, the significance of item mean comparisons was determined using the Bonferroni correction to alpha; thus, for questions on both the grade 3/4 and grade 7 surveys, $\alpha = 0.003$. Using the adjusted alpha, there was a statistical difference between paper and electronic media for twelve questions that grade 3/4s answered, and for eight questions that grade 7s answered. However, many of these showed only minimal effect sizes. Cohen's convention for effect sizes sets a small effect size at .20, a medium size at .40, and a large size at .80. According to these conventions, of the 14 questions that were statistically different for grade 3/4s, only one showed a medium effect; all others showed small effects. Similarly, only one of the 9 statistically

different questions for grade 7s showed a medium effect. (Table 5, below, shows item by item *t*-tests and effect sizes for grade 3/4s and Table 6, next page, shows item by item means and effect sizes for grade 7s).

The *t*-test measure of significance can be influenced by sample size, with larger sample sizes leading to increased significance levels. Therefore, it may be that differences between the paper and electronic media are of no practical significance (Marshall, 2007). This would certainly be supported by our finding that only one question had an effect size larger than 0.3.

Table 5: Item Mean Comparison and Effect Sizes for Grade 3/4s

Question	T-Value	dF	p	Mean Difference	Effect Size
"Do you like school?"	3.89	32729.96	<0.001	0.040	0.04
"Do adults treat all students fairly?"	6.54	38757	<0.001	0.065	0.07
"At school, are you learning about how to stay healthy?"	-6.05	32661.67	<0.001	-0.076	0.06
"Are you getting better at reading?"	7.67	31380.42	<0.001	0.067	0.09
"Are you getting better at writing?"	12.04	31528.2	<0.001	0.112	0.12
"Are you getting better at math?"	4.68	31997.34	<0.001	0.044	0.04
"Are you getting better at using computers?"	32.59	26548.92	<0.001	0.385	0.37
"At school, do you get exercise (for example, physical activity or sports)?"	-2.87	38724	<0.001	-0.024	0.04
"At school, do you respect people who are different from you (for example, think, act, or look different)?"	2.83	32323.34	<0.001	0.022	0.04
"At school, do you participate in activities outside of class hours (for example, clubs, dance, sports teams, music)?"	9.52	31691.89	<0.001	0.135	0.10
"Do you feel safe at school?"	9.48	31669.11	<0.001	0.091	0.10
"Do teachers care about you?"	7.38	31071.82	<0.001	0.061	0.08

Table 6: Item Mean Comparison and Effect Sizes for Grade 7s

Question	T-Value	dF	p	Mean Difference	Effect Size
"Do you try to do your best at school?"	3.359	31133.38	0.001	0.028	0.04
"Do adults treat all students fairly?"	-6.842	31318.62	<0.001	-0.077	0.07
"Do your teachers help you with your school-work when you need it?"	-11.685	32507.49	<0.001	-0.105	0.12
"Are you getting better at reading?"	-3.511	31714.54	<0.001	-0.038	0.04
"Are you getting better at using computers?"	30.254	27447.92	<0.001	0.425	0.32
"Do you feel safe at school?"	-7.134	31813.77	<0.001	-0.075	0.08
"At school, are you bullied, teased, or picked on?"	7.935	31880	<0.001	0.092	0.08
"Do teachers care about you?"	-6.524	39819	<0.001	-0.072	0.07

Response Rates

As a measure of differences in response tendencies, response rates were calculated for each medium and grade. The results are presented in Table 7. The response rates were higher in both cases for the electronic survey; however, the response rates were very high (90% and above) and very similar across media.

Table 7: Response Rates by Survey Medium and Grade

Survey Medium	Number Distributed	Number Returned	Response Rate
Grade 3/4 Students			
Electronic	25,573	24,473	92%
Paper	17,187	15,568	91%
Grade 7 Students			
Electronic	16,411	15,052	92%
Paper	13,955	12,590	90%

Patterns of Missing Response⁵

As a measure of respondent error, the average percentage of missing cases for each survey medium was calculated by grade (Table 8). For all grades and media, the average percentage of missing cases was less than 1%. For grade 3/4s, the average percentage of missing cases in electronic surveys was 0.94%, compared to 0.89% for paper surveys. For grade 7s, the average percentage of missing cases was 0.61% and 0.75% for electronic and paper surveys respectively.

Table 8: Average Percentage of Missing Cases by Survey Medium

Grade	Survey Medium	
	Electronic	Paper
Grade 3/4	0.94%	0.89%
Grade 7	0.61%	0.75%

Patterns of missing response were determined first by creating a new dummy variable with values “response” and “non-response”. Chi-square tests of significance were then run for the resulting contingency tables, comparing electronic and paper media for each question (grade 3/4 and grade 7 survey responses were run separately.) To determine the effect size of the difference for these questions, odds ratios were calculated. These predict the likelihood of missing a question on the electronic survey as compared to the paper survey. Table 9 (next page) summarizes the questions for which significant differences were reported for grade 3/4, and shows the odds ratios associated with each. Table 10 (page 21) presents the same information for grade 7 responses.

Table 9: Missing Response Odds Ratios, Grade 3/4 Responses

Question	Chi	dF	p	Odds Ratio
"Do adults treat all students fairly?"	24.997	1	<0.001	0.55
"Do your teachers help you with your schoolwork when you need it?"	5.866	1	0.015	1.39
"At school, are you learning about how to stay healthy?"	19.084	1	<0.001	0.62
"At school, do you respect people who are different from you (for example, think, act, or look differently)?"	6.910	1	0.009	1.34
"Do you feel safe at school?"	10.357	1	0.001	1.40
"At school, are you bullied, teased, or picked on?"	16.367	1	<0.001	0.71
"Do teachers care about you?"	53.526	1	<0.001	1.92

Seven questions on the grade 3/4 survey showed a significant difference between paper and electronic media in terms of missing responses. However, the size of this difference, estimated through the calculation of odds ratios, is relatively unsubstantial. The largest difference is for the question, "do teachers care about you?", where respondents were 1.92 times more likely to miss the question on the electronic form than on the paper form. As well, questions that measure generally the same concept are not skipped in the same way. For instance, students responding to the electronic form were more likely to miss the question, "do you feel safe at school?", whereas they were less likely to miss the question, "at school, are you bullied, teased, or picked on?" Both of these questions provide an indicator of students' perception of safety, and the questions follow one another on both forms.

Table 10: Missing Response Odds Ratios, Grade 3/4 Responses

Question	Chi	dF	p	Odds Ratio
"Do you try your best at school?"	20.999	1	<0.001	0.58
"Do adults treat all students fairly?"	53.286	1	<0.001	0.43
"At school, are you learning about how to stay healthy?"	27.939	1	<0.001	0.53
"Are you getting better at math?"	7.212	1	<0.001	0.72
"Are you getting better at using computers?"	11.562	1	0.001	0.70
"At school, do you get exercise (for example, physical activity or sports)?"	7.278	1	<0.007	1.54
"At school, do you respect people who are different from you (for example, think, act, or look differently)?"	8.788	1	0.003	1.56
"At school, are you bullied, teased, or picked on?"	10.334	1	0.001	0.72
"Do you know how your school expects you to behave?"	32.020	1	<0.001	0.60

Nine questions on the grade 7 survey were found to have significant differences in the number of missing responses recorded between electronic and paper media. As with the grade 3/4 survey, the magnitude of these differences was rather small, with the largest difference occurring on the question, "do adults treat all students fairly", where students replying to the electronic form were 0.43 times as likely to miss the question as those responding to the paper form. A somewhat more definite pattern may be emerging in grade 7, where questions relating to learning and achievement (trying one's best at school, learning to stay healthy, and getting better at math and computers) show a lower likelihood of being missed on the electronic form.

Factor Analyses

For the Grade 3/4 students, both the electronic and the paper survey data sets produce three factors with eigenvalues greater than one. The total variance explained was 39.54% for electronic responses and 39.09% for paper responses. Table 11 (next page) and Table 12 (page 22) provide full details of the factor analyses for Grade 3/4 students.

Table 11: Grade 3/4 Factor Analysis, Electronic Survey Respondents

Question	Component		
	1	2	3
"Do you like school?"	.50	.28	.28
"Do you like what you are learning at school?"	.47	.31	.31
"Do you try to do your best at school?"	.14	.58	.00
"Do adults in the school treat all students fairly?"	.70	.09	.06
"Do your teachers help you with your schoolwork when you need it?"	.56	.12	.21
"At school, are you learning about how to stay healthy?"	.32	.02	.59
"Are you getting better at reading?"	.11	.66	.09
"Are you getting better at writing?"	.13	.67	.12
"Are you getting better at math?"	.14	.58	.08
"At school, are you getting better at using computers?"	.08	.44	.23
"At school, do you get exercise (for example, physical activity or sports)?"	.23	.16	.57
"At school, do you respect people who are different from you (for example, think, act, or look different)?"	.30	.42	.05
"At school, do you participate in activities outside of class hours (for example, clubs, dance, sports teams, music)?"	-.01	.20	.54
"Do you feel safe at school?"	.67	.18	-.06
"At school, are you bullied, teased, or picked on?"	-.46	-.06	.46
"Do you know how your school expects students to behave?"	.35	.29	.18
"Do your teachers care about you?"	.69	.15	.11

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 4 iterations.

Table 12: Grade 3/4 Factor Analysis, Paper Survey Respondents

Question	Component		
	1	2	3
"Do you like school?"	.48	.24	.39
"Do you like what you are learning at school?"	.47	.23	.43
"Do you try to do your best at school?"	.10	.63	.04
"Do adults in the school treat all students fairly?"	.67	.13	.10
"Do your teachers help you with your schoolwork when you need it?"	.52	.12	.23
"At school, are you learning about how to stay healthy?"	.30	-.03	.60
"Are you getting better at reading?"	.50	.61	.25
"Are you getting better at writing?"	.11	.60	.24
"Are you getting better at math?"	.13	.45	.27
"At school, are you getting better at using computers?"	.04	.18	.47
"At school, do you get exercise (for example, physical activity or sports)?"	.21	.15	.52
"At school, do you respect people who are different from you (for example, think, act, or look different)?"	.23	.58	-.05
"At school, do you participate in activities outside of class hours (for example, clubs, dance, sports teams, music)?"	-.09	.18	.52
"Do you feel safe at school?"	.68	.17	.00
"At school, are you bullied, teased, or picked on?"	-.49	-.13	.36
"Do you know how your school expects students to behave?"	.25	.45	.09
"Do your teachers care about you?"	.65	.14	.16

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 6 iterations.

Generally speaking, the same pattern of factor loadings can be identified for both electronic and paper survey respondents at the Grade 3/4 level. Three distinct factors, measuring school environment (component 1 in Table 11, page 22, and Table 12, previous page), achievement or learning (component 2), and extracurricular activities (component 3) are identifiable regardless of medium, and with the exception of two questions, the loading patterns are comparable. The two exceptions are the question, “do you know how your school expects students to behave?” and “At school, are you getting better at using computers?” The former question loads in component 1 (school environment) for electronic survey respondents and component 2 (achievement or learning) for paper survey respondents. The computer question loads on component 2 for the electronic group and component 3 for the paper group.

For the Grade 7 students, the electronic survey data produced three factors with eigenvalues greater than one, while the paper survey data produced four factors with eigenvalues greater than one. For comparison purposes, a fourth factor was included for the Grade 7 electronic survey data. The total variance explained was 45.69% for electronic responses and 48.16% for paper responses. Table 13 (next page) and Table 14 (page 25) show the Grade 7 factor analysis results.

Table 13: Grade 7 Factor Analysis, Electronic Survey Respondents

Question	Component			
	1	2	3	4
"Do you like school?"	.49	.28	.36	-.03
"Do you like what you are learning at school?"	.53	.35	.29	-.10
"Do you try to do your best at school?"	.27	.20	.56	-.08
"Do adults in the school treat all students fairly?"	.74	.15	.05	.14
"Do your teachers help you with your schoolwork when you need it?"	.66	.25	.03	.12
"At school, are you learning about how to stay healthy?"	.36	.46	.07	-.02
"Are you getting better at reading?"	.21	.77	.13	.02
"Are you getting better at writing?"	.21	.73	.21	.06
"Are you getting better at math?"	.20	.54	.23	.08
"At school, are you getting better at using computers?"	.14	.62	.07	.03
"At school, do you get exercise (for example, physical activity or sports)?"	.20	.29	.44	.15
"At school, do you respect people who are different from you (for example, think, act, or look different)?"	.36	.00	.55	.06
"At school, do you participate in activities outside of class hours (for example, clubs, dance, sports teams, music)?"	-.10	.16	.72	.09
"Do you feel safe at school?"	.52	.18	.19	.51
"At school, are you bullied, teased, or picked on?"	-.06	-.02	-.04	-.91
"Do you know how your school expects students to behave?"	.55	.16	.35	.01
"Do your teachers care about you?"	.76	.23	.11	.09
"Are you aware of the school goals for improving student learning?"	.48	.31	.31	-.01

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 7 iterations.

Table 14: Grade 7 Factor Analysis, Paper Survey Respondents

Question	Component			
	1	2	3	4
"Do you like school?"	.47	.45	.11	.07
"Do you like what you are learning at school?"	.52	.43	.15	.00
"Do you try to do your best at school?"	.18	.66	-.05	.02
"Do adults in the school treat all students fairly?"	.72	.12	.06	.14
"Do your teachers help you with your schoolwork when you need it?"	.64	.07	.19	.13
"At school, are you learning about how to stay healthy?"	.45	.11	.42	-.08
"Are you getting better at reading?"	.15	.64	.33	-.05
"Are you getting better at writing?"	.13	.69	.31	.03
"Are you getting better at math?"	.11	.58	.22	.11
"At school, are you getting better at using computers?"	.21	.15	.55	-.15
"At school, do you get exercise (for example, physical activity or sports)?"	.25	.06	.64	.09
"At school, do you respect people who are different from you (for example, think, act, or look different)?"	.31	.41	-.11	.13
"At school, do you participate in activities outside of class hours (for example, clubs, dance, sports teams, music)?"	-.06	.16	.62	.17
"Do you feel safe at school?"	.50	.18	.09	.54
"At school, are you bullied, teased, or picked on?"	-.04	-.04	-.04	-.88
"Do you know how your school expects students to behave?"	.50	.31	.04	-.04
"Do your teachers care about you?"	.75	.16	.14	.07
"Are you aware of the school goals for improving student learning?"	.47	.31	.22	-.12

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 6 iterations.

For Grade 7 students, four factors were identified: the same three components initially identified for Grade 3/4 students (school environment, achievement or learning, and extracurricular activities) and an additional factor having to do with safety. Again, patterns of response were similar across the survey media. However, four questions loaded differently for electronic respondents versus paper respondents. The question, “Do you try your best at school?” loaded as component 3 (extracurricular activities) for electronic survey respondents, and as component 2 (achievement or learning) for paper survey respondents. “At school, are you learning to stay healthy?” loaded as component 2 for the electronic group and as component 1 for the paper group. Like the Grade 3/4 students, the question, “At school, are you getting better at using computers?” loaded as an achievement or learning question for electronic survey respondents, but as an extracurricular activity question for paper respondents. Finally, “At school, do you learn to respect people who are different from you?” loaded as component 3 for the electronic group and as component 2 for the paper group.

To determine whether the factor structures of paper versus electronic responses were invariant, a Procrustean rotation was used to fit the structure of electronic responses to the best-fit position with that of paper responses. If the models are invariant, then the factor cosines from the first group will be strongly correlated with those of the second group, indicating a similar underlying structure. This provides a statistical measure of invariance to complement the analytical evidence discussed above.

For grade 3/4 students, there was little detectable variance in the rotated factor structures. Table 15 shows that the three factors that emerged from the electronic survey factor analysis are highly correlated to those that emerged from the paper survey analysis: there is a 0.997 correlation between the first factors for each group; a 0.983 correlation between the second factors, and a 0.986 correlation between the third factors.

Table 15: Factor Cosine Correlations for Grade 3/4 Paper and Electronic Surveys

	Factor 1-B	Factor 2-B	Factor 3-B
Factor 1-A	0.997	0.077	0.030
Factor 2-A	-0.081	0.983	0.165
Factor 3-A	-0.017	-0.166	0.986

Grade 7 responses also demonstrated a high level of invariance. Table 16 shows that the four factors that emerged from the electronic survey factor analysis are highly correlated to those that emerged from the paper survey analysis. However, in this case, the second and third factors have been reversed. That is, while the first factors correlate with each other at 0.981 and the fourth factors correlate with each other at 0.922, the second and third factors do not correlate with each other. Instead, the second factor of the electronic survey analysis correlates with the third factor of the paper survey analysis at 0.935, while the third factor of the electronic survey analysis correlates with the second factor of the paper survey analysis at 0.938.

Table 16: Factor Cosine Correlations for Grade 7 Paper and Electronic Surveys

	Factor 1-B	Factor 2-B	Factor 3-B	Factor 4-B
Factor 1-A	0.981	0.105	-0.162	0.018
Factor 2-A	0.135	0.221	0.935	-0.244
Factor 3-A	-0.126	0.938	-0.125	0.299
Factor 4-A	0.057	-0.248	0.291	0.922

This suggests that some variance in factor ordering has occurred. As well, while all the factors from the electronic survey analysis correlated to those in the paper survey analysis, the correlations are slightly less strong as were found for the grade 3/4 responses. Further research into the causes of the reversal of factor cosine correlations could reveal subtle variances in the factor structures of each medium.

Discussion

The purpose of this study was to examine whether the medium of the Provincial Satisfaction Survey had any significant effect on its results – in other words, to compare the two media and look for differences that might suggest one medium was less reliable than the other.

Generally speaking, our results have shown that this is not the case. The average number of missing cases in either medium is negligible. Both media had high reliability, and the difference between media was minor. Electronic surveying was slightly more reliable for both grade 3/4's and grade 7's, despite the fact that there were a slightly higher number of average missing cases in surveys completed electronically. The higher reliability is likely due to the reduction of error in other aspects of the survey process - for instance, there are no opportunities for data entry or scanning errors with electronic surveys. Practically speaking, it appears that electronic surveys hold a slight advantage over paper in that the simplicity of administering them contributes to a greater overall reliability.

Item by item mean comparisons bear out this trend: although a number of questions in each grade were statistically different depending on medium, the size of these differences was negligible. The only exception to this was the question, “at school, are you getting better at using computers?” – a medium effect size was found for the mean difference on this question, with students completing an electronic survey reporting higher levels of agreement than those filling out a paper survey. This is consistent with Carini, Hayek, Kuh, Kennedy and Ouimet's (2003) finding that answering questions about computer technology while using that same technology will result in higher satisfaction. Even so, it should be noted that students' responses were quite positive, regardless of the survey medium.

Over-inflation of statistical significance may be an issue due to the large sample size. This means that some of the questions for which statistical differences between media were found are not substantively different. This reinforces the trend of our findings, where we have seen little evidence to suggest that survey medium meaningfully affects response patterns.

Both survey media have high response rates, and there is very little difference between the two. Electronic surveys tended to have higher response rates (by 1 or 2%) in both grades; again, this likely is related to the method of administering the survey: while a student may write all over his or her paper survey, rendering it impossible to scan and thus impossible to analyze, electronic surveying limits this kind of activity. The ‘rules’ for responding are programmed into the design of the survey, such that a

question may be answered or skipped, but no additional information (such as comments or drawings) that might render a response invalid can be included.

When patterns of missing response are analyzed, while seven questions on the grade 3/4 survey and nine questions on the grade 7 survey have significant differences in non-response between electronic and paper forms, these differences are small in magnitude. There appears to be little evidence that a distinct pattern of non-response related to a particular subject or the order of questions on the survey instrument exists, although a pattern of fewer missing responses on the electronic form for questions relating to learning and achievement may be emerging in grade 7 responses. Given the small number of missing cases overall, however, it is impossible to confirm whether a pattern exists, or whether the distribution of missing cases is random, especially given the likelihood that chi-square statistics will be significant in large sample sizes.

Generally, the factor analyses indicated little substantive difference between the patterns of response on electronic versus paper surveys. Only two questions for Grade 3/4 students and four questions for Grade 7 students loaded on different factors for electronic surveys than they did for paper surveys. Most notable of these is, again, the question about computer satisfaction. For those respondents who filled the survey out on a computer, the satisfaction question regarding computers loaded on the 'achievement or learning' factor. Paper survey responses resulted in this question loading on the 'extracurricular activities' factor. This is not surprising. Students who were filling out the questionnaire electronically were engaged in using computer technology for school-related work in that the survey was completed using the school computer lab, and administered by school staff. Thus, it would make sense that they viewed computers as part of their education. Those who filled out the paper surveys may not have been thinking of the use of computers as an educational tool when answering the questions, especially given the number of recreational uses for children that computers could represent. As with item means, this measure of comparison suggests that responses to questions related to computer technology do vary depending on survey medium.

When the two media were rotated to best-fit position with each other, very little invariance was revealed. For the grade 3/4 surveys, the factor cosines for each emerging factor were highly correlated, suggesting an invariant underlying factor structure. For the grade 7 surveys, the correlation between factors remained high, but not as high as those of the grade 3/4 responses, and two of the factors (factors 2 and 3) were reversed, such that factor 2 of the electronic survey analysis correlated with factor 3 of the paper survey analysis and vice versa. This suggests that there may be

some difference in the ordering of factors between the paper and electronic surveys; further research would need to be conducted in order to account for that discrepancy.

In short, the differences between electronic and paper media for this study appear to be minor, and do not seem to have a significant effect on overall results. This bodes well for the use of electronic surveying, since electronic methods of administration do have practical advantages over traditional paper surveys: they are easier to administer, are more cost-effective, allow for shorter turnaround times in data processing, and require less coordination between different groups (such as the departments of education, school districts, schools, mail services, and couriers) than paper surveys do. Since the administration of the survey, for younger students at least, is conducted nearly the exact same way with each medium, biases resulting from the survey medium appear to be minimal.

Our findings are consistent with recent research into the use of electronic forms for testing and assessment in schools; for example, Poggio, Glasnapp, Yang and Poggio (2005) found very little difference in performance between computer based and paper and pencil test media. Similarly, electronic surveying stands up to the test: it is just as valid and reliable in these circumstances as traditional paper surveys.

Limitations

Our conclusions must be tempered by an understanding of the limitations of this study. One important limitation is that this was not a true experimental design. In a true experiment, a representative sample of students would have been selected and randomly assigned to either the paper or the electronic survey medium. This study, however, capitalizes on data already being collected for a different purpose. The British Columbia Provincial Satisfaction Survey aims to be a census of students in particular grades; it is designed to be of use primarily at the school level, rather than at an aggregated provincial level (although provincial results are certainly reported). Electronic surveying was implemented not to determine the validity of the method, but as an alternative method of survey administration that might potentially increase accessibility and decrease costs.

A further consideration had to do with the way in which electronic surveying was implemented. Individual districts chose whether or not electronic surveying would be used; after this decision was made, individual schools still had the option to opt out and use paper surveys if they felt it was the better administrative choice. It is conceivable that differences that seem to be due to survey type could actually be a result of the decisions of the district or school in which a respondent is located.

Indeed, of the sample variables collected, only region was substantially different, with more regions outside of the Lower Mainland opting to use electronic surveying than those inside the Lower Mainland. This suggests that there may be some differences between school districts, particularly around the availability and accessibility of technology required to implement electronic surveying. However, this 'self-selection' is happening at the school level, not the respondent level, which may minimize the effect at the individual level with which our analysis is concerned.

A final limitation of this study is that we did not conduct a confirmatory factor analysis in order to undertake a comprehensive evaluation of structural invariance. We feel that since the factor analyses were meant to supplement our other findings and were therefore not the central measure of comparison in this study, the Procrustean rotation on our exploratory factor analyses provides enough evidence to support our conclusions. However, this is not to suggest that a more thorough investigation of measurement invariance would not reveal subtle distinctions between the two survey media. Indeed, we believe that these distinctions, if they existed, could reveal important differences between paper and pencil surveys and electronic versions, especially when considering respondent groups that are not as familiar with surveying in general, such as children. A complete confirmatory factor analysis examination of measurement invariance would be, therefore, an excellent way to take this research further in the future.

Conclusion

In conclusion, it appears that electronic surveying and paper surveying produce very similar results. This suggests that the use of the electronic medium to administer a large-scale survey like the BC Provincial Satisfaction Survey does not pose any threats to the validity or reliability of survey results. In fact, the use of electronic questionnaires may be advantageous, especially in surveying children; practical limits on responses prevent children from rendering their surveys unusable by drawing or writing in the response space and spoiling the form. Using computers is fun for children, making the survey a pleasant experience, and with the exception of questions about computers, the use of this medium does not seem to change or bias response patterns.

Endnotes

1. Schools with no Grade 4 students administered the survey to Grade 3 students, their parents, and school staff.
2. Dillman's (2000) principles were developed with adult respondents in mind. Some of these principles were not applicable to surveying children, or to census surveys administered in school settings.
3. Parent surveys, for example, were sometimes brought home by students to be filled out by parents and then returned. Sometimes they were mailed. Sometimes a password to access an electronic copy was sent home and sometimes parents came in to the school to fill out electronic surveys, and so forth. These different methods of administration were adopted by districts in order to maximize responses, and were determined purely by practical concerns.
4. Non-Standard School: includes the following public school facility types: Continuing Education, Distance Education School – paper based program, Alternate Programs, Youth Custody, Long Term Provincial Resource Program, Electronic Program – in a district, and Electronic Program – Distance Education.
5. Cases were coded as missing if: no response value was entered (electronic and paper surveys), multiple responses were entered (paper surveys only), or invalid responses were entered (paper surveys only). Invalid responses included such things as striking a line through the response options, marking a dot between two response options, and so forth.

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References

- Abdi, H. (2007). The Bonferroni and Sidak corrections for multiple comparisons. In Salkind, N. (Ed). *Encyclopedia of Measurement and Statistics*. Thousand Oaks: Sage. Retrieved March 3, 2008 from <http://www.utdallas.edu/~herve/Abdi-Bonferroni2007-pretty.pdf>
- British Columbia Ministry of Education. (2004). Provincial Satisfaction Survey Technical Report. Retrieved December 10, 2004 from www.bced.gov.bc.ca/sat_survey/04survey_tech_report.pdf
- Carini, R.M., Hayek, J.C., Kuh, G.D., Kennedy, J.M., & Ouimet, J.A. (2003). College student responses to web and paper surveys: Does mode matter? *Research in Higher Education*, 44(1), pp. 1–19.
- Crawford, S.D., Couper, M.P., and Lamias, M.J. (2001). Web surveys: perceptions of burden. *Social Science Computer Review*, 19(2), pp. 146–162.
- Daley, E.M., McDermott, R.J., Brown, K.R.M, & Kittleson, M.J. (2003). *American Journal of Health Behavior*, 27(2), pp. 116–124.
- Dillman, D.A. (2000). *Mail and Internet Surveys: The Tailored Design Method*. New York: John Wiley and Sons.
- Kaye, B.K. & Johnson, T.J. (1999). Research methodology: Taming the cyber-frontier. *Social Science Computer Review*, 17(3), pp.323–337.
- Marshall, M. (2007). Personal communication, Feb. 20, 2007.
- Moss, J. & Hendry, G. (2002). Use of electronic surveys in course evaluation. *British Journal of Educational Technology*, 33(5), pp.583–592.
- Nesbary, D.K. (2000). *Survey Research and the World Wide Web*. Massachusetts: Allyn & Bacon Press.
- Poggio, J., Glasnapp, D., Yang, Z., & Poggio, A. (2005). A comparative evaluation of score results from computerized and paper and pencil mathematics testing in a large scale state assessment program. *Journal of Technology, Learning, and Assessment*, 3(6). Retrieved December 2, 2005 from http://www.bc.edu/research/intasc/jtla/journal/pdf/v3n6_jtla.pdf.
- Solomon, D.J. (2001). Conducting web-based surveys. *Practical Assessment, Research and Evaluation*, 7(19). Retrieved July 9, 2004 from <http://PAREonline.net/getvn.asp?v=7&n=19>.

Thompson, B. (2004). *Exploratory and Confirmatory Factor Analysis: Understanding Concepts and Applications*. Washington DC: American Psychological Association.

Webster, J. & Compeau, D. (1996). Computer-assisted versus paper-and-pencil administration of questionnaires. *Behavior Research Methods, Instruments, and Computers*, 28(4), pp. 567–576.

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