Measuring a university institutional image among senior high school students

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Abstract

We applied a sampling plan oriented to collect reliable information on del Valle University, Cali, Colombia, from senior high school students in the university's area of influence. The university made the decision of characterizing this population through a sampling survey, given the fact that these students represent the main population the university is intended to serve. To select the students, we started by determining the principal characteristics of the main and sampling population (schools), to continue then, with the number of high schools to be included in the sample, as well as sample distribution among the cities, where the sampling will be carried out. Within each sampled city we selected four domains, according to whether or not, the high schools were state or non-state and academic or non-academic. Once established the high schools to be included in the sample, we visited each one of them, and surveyed all the students of the first group, of class 11 at each school. We configured a sample per clusters in a single stage, with proprotional distribution per city, to take into account the size of each city, according to the number of schools and the amount of grade-11 students taking the 2008 version of the SABER 11 examination, since we did not have access to information on the number of students registered for last grade (11) in 2010. We explained the sampling plan, and present the main standards and their estimates.

Key words: Sampling design, cluster sampling, image perception.

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Introduction

Del Valle University, as a part of its institutional policy, explored perception on its image, parting from versions, or voice from various sectors and actors of the community, both region and nationwide, taking into account direct beneficiaries and indirect from the university formation, research, and social projection. One of these beneficiary groups is composed of secondary students, and one of the main purposes of study (Renteria et al, 2012) is to research on perception about university image among this particular object group.

The study was restricted to the University geographic area of influence, mainly located in the states of Valle de Cauca, Risaralda, Quindio, Cauca, and Nariño. But, interviewing all students of such area of influence is a task too large enough as to attempt it. Therefore, a key step in the measuring process was selecting members of object group to be finally surveyed.This work refers to sampling general methodology used in the study of object group composed of secondary students, which was limited to those taking the last grade (11), at education schools with the area of influence, parting from the fact that the next step in their academic formation will be selecting of a college academic program.

Perception measurements in education are common in literature, but sampling procedures are not necessarily suitable. For example, Bhatnagar (2008), performed his Master research on secondary student perception about technology and its influence on the intention of selecting any career at a technological institute, investigating whether difference of gender exist. His sampling plan included selecting some students from two schools of the region where the university is located. 71 students were selected from the first school, among them 30 women; 81 students were selected from the other school, including 50 women. In summary, the sample consisted of 152 students taking grades 9 to 12, from two schools. The report does not mention reasons to select these sizes of sample, and although more observations were taken at the largest school, sample size distribution is not proportional to the school size. That is, the sampling plan does not seem to follow statistical results fairly well prepared.

In another article, Gassel (2007), prepared a sampling plan for a review on perceptions, expectations and demand by young individuals regarding middle education in Panama. The author claims having used simple random sampling, but then, he states that he will use a proportional assignation, typical of stratified sampling plans. And finally, he selects at each school a full classroom group, as it would be done in sampling by clusters. That is, he did not use a simple random sampling plan, as he states. In fact, he seems to have used a stratified sampling plan by clusters in one stage. Hence, his sample size calculations little help him to ensure quality of his estimations.

Silas (2012), reports analysis of answers to a survey by 329 students, aged between 16 and 18. These students are from three private schools, and two public ones located on two states of Mexico. The author says that it is a quantitative study, but he does not report how such 329 students, taking the survey, were selected. Therefore, conclusions present the opinion of this group of people, but its generalization is questionable, at least from the statistical point of view.

In a study on students perception of a university on evaluation processes about curses given by teachers, Heine and Maddox (2009), administered a questionnaire to 319 students, selected at random at the Faculty of Business Management of a university. The sample included more last year students than first year, and equal number of individuals attending intermediate years. The same proportion of men and women was included. However, the report does not mention how the sample size was selected.

Other authors such as Xu (2011), Aignerén et al (2009), Office of Administrative Planning and Finance –National University of Colombia (Medellin office), (2006), Port et al (2012), presented studies based on samples, which common feature is absence of technical justification in selecting sample size. This work proposes a general methodology, to prepare a sampling plan for this type of studies and illustrates its application of Renteria's et al (2012) case of study.

The purpose is to design a sampling plan to meet the main purpose of the project *Study of university image perception for del Valle University Nationwide,* financed by funds from del Valle University, vice rector office of research. The pupose is to explore perception on its image, parting from versions, or voice from various sectors and actors of the community, both region and nationwide, taking into account direct beneficiaries and indirect from the university formation, research, and social projection. In this order of ideas, it is very important to learn about perception of last year H.S. students, which population will become the raw material to prepare under graduate academic plans, for which purpose a sampling model is suggested for 11-grade urban-day-class students, in the following del Valle University area of influence: Armenia, Buenaventura, Buga, Cali, Palmira, Pasto, Pereira, Popayan, Santander de Quilichao and Tulua, all of them important cities located in Colombian Southertern.

At first the proposed sampling plan is presented, illustrating steps with the case study, to end discussing results, and the most important conclusions.

Materials and methods

In order to prepare the sampling design, its components are firstly identified, as follows: researched population, sampling to be used, sample size determination, and, finally design of field work (Klinger, 2011).

Population of interest is composed of 11-grade students, restricted to urban areas of the above mentioned del Valle University influence cities. This coverage is determined by presence of the university branches in such cities, and considerable presence of students from these cities enrolling the university, having completed their H.S. at schools of these cities. Temporal coverage considers years 2009 and 2010, and subjects located at object population are required to be 11-grade students of day or evening class schools, located in geographic coverage cities, and referenced by municipal or state secretaries of education.

Available sample framework for the study is a list of middle education schools, reported by Municipal or State Secretaries of Education for cities defined within the geographic

area of the project. Schools located in the rural area of referred cities, considered as not running grade 11 of middle education, were withdrawn from such list. Through this list, the school is approached, and then, access to 11-grade students is available. It was dediced to take a single 11-grade group per school, and survey those students present in such group, in order to ensure proper coverage of the school, and hence facilitate calculation of answers given by them. In particular, the group at each school identified as the first 11-grade group, wa selected, for example, group 11-1 or grade 11-A. That is, a sampling plan for clusters in a single state is proposed, in which the school is chosen at random. To collect answers from students of each school, there is no evidence which allows to anticipate that perception of grade-11 students vary from group to group within the same school, therefore, there is no reason to believe that election of any grade-11 group may introduce any slant in measurements. Election of the first group is merely operative.

In determining the required sample size, it was used as a standard of research, the proportion of grade-11 students of object population who consider that for del Valle University, it is very characteristic or fully characteristic the statement: "Careers provided by del Valle University are the ones that the region and the country need".

Sampling method used was the random sampling of clusters in a single stage with proportional assignment per city. In this context, a school is selected from the sampling framework, and all students of a single 11-grade group are interviewed, which technically is a cluster. Proportional assignment implies that larger cities providing more contribution to population size, will contribute more to the sample size.

In addition, Colombian education system allows existence of state schools (which essentially operate using state funds), and non-state schools (essentially operating using private funds). At the same time, these schools may award academic degrees (which prepare students to continue their higher education, with no development of particular technical skills for employment), and, other schools that prepare students who, notwitstanding being prepared to enter higher education, are also trained for employment. This later group is named in this study as non-academic schools. In order to minimize a possible slanting on measurement, due to selection of a higher number of a single-type schools, it was decided to arrange the sample, in such a manner as to ensure presence of schools belonging to each of the four possible dominions, as follows: State and Academic (ST-AC); Non-State and Academic (NST-AC), State and non-Academic (ST-NAC), and non-State and non-Academic (NST-NAC).

The final sample of schools included for each city of coverage, a number of schools in each dominion obtained on proportional basis; both the amount of schools per dominion in each city, and the amount of schools per city, were determined proportionally to the number of students having taken SABER 11 examinations in 2008, taking into account the impossibility of obtaining the number of students registered at each school of the population, which was formed by 1043 schools included in the sampling framework (Chart 1).

In estimating the proportion of interest, it was determined an error estimation of maximum 8.5% (higher difference between estimation and the standard), and confidence level of 95%. Expression (1) shows how the number of schools required for the whole coverage of study, in such a manner that maximum estimation error, and expected significance level are met.

$$n = \frac{z^2_{a2 \cdot P(1-p)}}{\sigma^2} = \frac{(1.96)^2(0.25)}{(0.085)^2} \cong 137$$

Chart 1. Number of schools per dominion in each city. Academic state schools are labeled OF-AC; academic non-state, NOF-AC; non-academic state, OF-NAC and non-academic non-state, NOF-NAC.

School Classification

City	OF-AC	NOF-AC	OF-NAC	NOF-NAC	Total
Armenia	33	1	23	4	75
Cali	4β	17	72	1	488
Buenaventura	18	2	13	2	75
Buga	3	1	9	8	33
Palmira	17	2	12	1	66
Pasto	20	2	21	7	69
Pereira	42	2	13	1	96
Popayán	32	4	11	7	90
Santander de Quilichao	6	1	3	0	19
Tuluá	12	1	5	5	32
Total	229	35	182	2	1,043

This number of schools corresponds to 13.14% of schools composing the population in study. Correction for finite population is not included, because its use would lead to a reduction of sample size (Ospina, 2001:88). Etimator standard error will be lower with a larger sample size, which leads to more accurate estimations, that is, to a minor estimator variance.

The 137 schools of the sample were distributed in the 10 cities according to the percentage (W_h) of students taking SABER 11 tests in 2008 (Table 2)

Table 2. Number of students taking SABER 11 tests in 2008, classified by city included in the study.

City	Nr. Of Students taking SABER 11 tests in 2008	City percentage (W_h)
Armenia	3,952	0.076
Cali	22,68	0.434
Buenaventura	2,906	0.056
Buga	1,357	0.026
Palmira	3,067	0.059
Pasto	4,942	0.095
Pereira	5,785	0.111
Popayan	4,138	0.079
Santander de Quilichao	857	0.016
Tulua	2,623	0.050
TOTAL	52,307	

Upon defining the number of sampled schools, they are distributed in the ten cities of del Valle University influence, according to weighting (2).

$$n_h = W_h n = \frac{E_h}{E}.n \qquad (2)$$

Weighting (2) shows:

N_h = *Nr. Of schools to be sampled in the city*

E_h = *Total Number of students taking SABER 11 tests in 2008, who belong to a school of city h.*

E = Total Number of students taking SABER 11 tests in 2008, in cities covered by the study.

In Weighting (2):

The 137 schools were distributed according to percentage of students taking SABER 11 tests – 2008, obtaining the distribution shown in table 3.

Table 3. First approach to distribution of schools sample per city:

City	Estimated n_h
Armenia	10
Cali	59
Buenaventura	8
Buga	4
Palmira	8
Pasto	13
Pereira	15
Popayan	11
Santander de Quilichao	2
Tulua	7
TOTAL	137

For a better representation of schools in each city, once classified in four dominions, it was determined, according to variable number of students taking SABER 11 tests in 2008, the number of schools to be included in each dominion per city, as appeard in equation (3)

$$n_{h\,(i,j)} = W_{h(i,j)} \cdot n_h = \frac{E_{h(i,j)}}{E_h} \cdot n_h$$

In equation (3):

$E_{h(In)}$: *Number of grade 11 students taking SABER 11 tests in 2008, who belong to a school of city h classified in dominion (I,j)*

$E_{h:}$ $_{Total\,n}$*umber of students taking SABER 11 tests in 2008, who belong to a school of city h.*

$N_{h(ij}$: *Number of grade 11 schools samapled in the dominion (I,j) in city h*

$N_{h:}$ *Number of schools samapled in city h*

According to the above, the sample of each city was distributed as described in Table 4. It is seen that, at calculating sample size per dominion, with approximations upward, necessary to obtain whole numbers, the number of schools to be sampled, the original size of 137 schools increases to a new total of 158. No answer cases again modify this size, and a final sample size of 146 schools is achieved in the 10 cities. (Table 4).

* Refers to the number of schools actually sampled, affected by no answer cases.

Once the number of schools per dominion in each city is estimated, schools to be systematically visited are selected based on sampling frameworks of each city and dominion, using the list of schools per dominion in the city. The systematic method allows, once the first school of the list within the rank is selected at random, to select the remaining ones from the dominion (I, j) of city *h* at jumps of equal constant longitude. This systematic sample, executed upon selecting at random from the list of schools within each city, very well reproduces properties of a simple aleatory sample. In fact, according to Ospina (2001:143) "if population may be considered as arranged on aleatory basis, efficiency of systematic sampling is equal to that of the simple aleatory sampling".

Final estimated total sample resulted to be of 158 schools distributed in defined dominions. Table 4 shows the total performed in the field work. Non-answer cases were due to denial by some school directors and problems related to calendar of another schools, therefore, it was not possible to comply with school proportion in the various dominions of cities, although we complied with the sample at its first approach for error level and confidence level as established. These non-answer cases are widely covered by the final sample size, which is much larger than the intended sample size and, of course, even larger than the one which would be obtained by using a correction for finite population. Table 4 shows that not always the total sampled schools is lower than the intended one.

Table 4. Distribution of schools sample of each city in the four dominions

City	OF-AC	NOF-AC	OF-NAC	NOF-NAC	Total Estimate	Actual total*
Armenia	5	2	5	1	13	11
Cali	8	16	19	17	60	63
Buenaventura	3	2	3	2	10	11
Buga	1	1	3	1	6	5
Palmira	2	2	4	1	9	9
Pasto	4	2	6	2	15	10
Pereira	9	3	4	2	18	14
Popayan	5	4	3	1	13	14
Santander de Quilichao	1	2	1	0	4	4
Tulua	4	3	1	2	10	5
TOTAL					158	146

Taking into account that sampling design for established population is an aleatory sampling by different size cluster in a single stage, (one cluster is formed by a group of students consistent with grade-11 student population), involved estimators for proportion and their respective variances are defined in expressions (4) and (5). It should be taken into account that, because of the importance of covering dominion proportions in the cities, it was necessary to consider the sample in each city, as a simple aleatory sample with no weighting per dominion, for purposes of calculating local estimates. These expressions are adaptations fixed to notation used in this work, of Ospina's general expressions (2001:222)

City standards are defined in expressions (4),

$$P_h = \frac{\sum_{i=1}^{N_h} A_{hi}}{\sum_{i=1}^{N_h} M_{hi}}; \quad V(\hat{P}_h) \cong \frac{(N_h - n_h)}{N_h n_h \overline{M}_h^2} \sum_{i=1}^{N_h} \frac{(A_{hi} - P_h M_{hi})^2}{N_h - 1} \quad (4)$$

Where:

$P_{h=}$ Porportion of students who in city *h* hold the studied attribute

$V(P_h)$ = Estimated proportion variance of students who in city *h* hold the studied attribute

A_{hi} = Number of students who at shool *i* of city *h* hold the studied attribute

M_{hi} = Number of grade 11 students at school *i* of city *h*

M_h = Average number of grade 11 students per school in city *h*

N_h = Number of grade 11 schools in city *h* composing the sample

wExpressions (5) define city estimators corresponding to standards defined in (4)

$$\hat{P}_h = \frac{\sum_{i=1}^{n_h} A_{hi}}{\sum_{i=1}^{n_h} M_{hi}}; \quad \hat{V}(\hat{P}_h) \cong \frac{(N_h - n_h)}{N_h n_h \overline{M}_h^2} \sum_{i=1}^{n_h} \frac{(A_{hi} - \hat{P}_h M_{hi})^2}{n_h - 1} \quad (5)$$

Where:

$\hat{P}_h$: Porportion of students who in city h hold the studied attribute

$\hat{V}(\hat{P}_h)$: Estimated proportion variance of students who in city h hold the studied attribute

Object population of study (all students of the ten cities of influence), have standards and estimators described in expressions (6) and (7)

$$P = \sum_{h=1}^{10} W_h P_n; \qquad \hat{P} = \sum_{h=1}^{10} W_h \hat{P}_h \qquad (6)$$

$$V(P) = \sum_{h=1}^{10} W_h^2 V(P_n); \quad \hat{V}(\hat{P}) = \sum_{h=1}^{10} W_h^2 \hat{V}(\hat{P}_h) \quad (7)$$

Results

An instrument prepared to be filled up by surveyed individual was used, such instrument was provided to each student, following an introducition by a professional coordinator, in charge of collection.

The coordinator at each city was previously trained by directors of the project, on how to perform the field work; such coordinator was provided with manuals/ guidance, as well as the sample of school he should approach. Upon completing the work, each coordinator reported, on electronic form, the surveys, and mailed physical support of each survey. For this purpose, an office was made available, including personnel for telephone daily attention, and electronic. In no case, such coordinator determined himself the school where he should perform the survey. In the case of impossibility, the school was replaced by another of the same dominion and city, on aleatory basis, by the direction of the project, as possible.

According to the above explained model, and the field work performed, the resulting sample presented sampling fractions calculated in (8) and (9).

Regarding school sample:

$$f_C = \frac{n}{N} = \frac{\sum_{h=1}^{10} n_h}{\sum_{h=1}^{10} N_h} = \frac{146}{1043} = 0.1399 \quad (8)$$

Regarding sampled grade-11 students:

$$f_E = \frac{Surveyed\ grade\ 11\ students}{Total\ grade\ 11\ students} \cong \frac{4050}{45003} = 0.0899 \quad (9)$$

At this last representation, the number of surveyed students appear in table 5.

Table 5. Number of students surveyer per city

City	Number or surveyed students
Cali	1.728
Armenia	287
Buenaventura	303
Buga	147
Palmira	274
Pasto	335
Pereira	365
Popayan	365
Santander de Quilichao	108
Tulua	138
TOTAL	4,05

For illustration purposes, results corresponding to the first four items of the survey applied to grade-11 students, selected in the sample, are presented, as follows:

Item 1. Careers offered by del Valle University are the ones that the region and the country need.

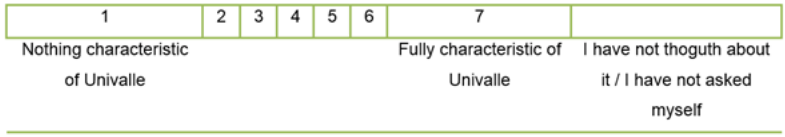
Item 2. Any one may apply for enrolling del Valle University, because there equal opportunity.

Item 3. Careers provided by del Valle University are excellent

Item 4. Demanding level to enroll del Valle University is high

In the instrument applied to each item, the student should assign a value between 1 and 7, according to grading rule illustrated in Figure 1.

Figure 1. Instrument answer form



The purpose is to estimate for each item, the proportion of grade-11 students assigning this item either 6 or 7, which represent possible answers that allowed to consider an item as highly characteristic of del Valle University. These proportions are represented by $p_{1'}$ $p_{2'}$ $p_{3'}$ and $p_{4'}$, respectively.

According to the above, table 6 shows proportions estimated for each items, representing perceptions of grade-11 students surveyed at each city covered by the study.

Table 6. Proportion of students considering items 1 to 4 as highly characteristic of del Valle University

City	p_1	p_2	p_3	P_4
Cali	0.657	0.517	0.831	0.852
Armenia	0.327	0.504	0.381	0.535
Buenaventura	0.604	0.443	0.632	0.543
Buga	0.408	0.476	0.565	0.537
Palmira	0.646	0.600	0.804	0.760
Pasto	0.445	0.516	0.558	0.481
Pereira	0.137	0.209	0.192	0.146
Popayan	0.411	0.482	0.585	0.411
Santander de Quilichao	0.593	0.546	0.750	0.741
Tulua	**0.490**	**0.594**	**0.580**	**0.615**

Table 7 shows estimations of the respective variances of each estimated proportions appearing in table 6.

Table 7. Estimated variances ($V_{1'}$ $V_{2'}$ $V_{3'}$ V_4), of proportions $p_{1'}$ $p_{2'}$ p_3 and p_4

City	v_1	v_2	V_3	V_4
Cali	0.000248	0.000255	0.000126	0.000160
Armenia	0.001445	0.003392	0.002096	0.005482
Buenaventura	0.001102	0.000877	0.002151	0.001816
Buga	0.001971	0.005000	0.005669	0.003875
Palmira	0.002094	0.001577	0.001109	0.001948
Pasto	0.000966	0.000496	0.001438	0.001208
Pereira	0.000311	0.000892	0.000527	0.000563
Popayan	0.000988	0.000316	0.000985	0.000537
Santander de Quilichao	0.001647	0.008162	0.000620	0.004254
Tulua	0.003876	0.001218	0.006340	0.003623

Global estimation is used for the same proportions previously analyzed, that is, considering grade-11 student population of those schools included in the geographic area of the study, composed of the 10 cities under del Valle University influence. Likewise, 95% confidence interval is used for each. Global estimations and limits of the respective confidence intervals are shown in table 8.

Item	Global-estimator	Lower limit	Higher limit
p_1	0.515	0.496	0.535
P_2	0.483	0.464	0.503
P_3	0.640	0.621	0.659
P_4	0.640	0.620	0.860

Table 8. Estimated global proportions ($p_{1'}$ $p_{2'}$ $p_{3'}$ and $p_{4'}$) for the first four items:

That is, with a 95% of confidence:

Between 49.6 and 53.5% surveyed students considered as very characteristic of the University that "careers provided by del Valle University, are the ones the region and the country need".

From 48.3 to 53.5% students believe as very characteristic that "at del Valle University, any one may apply to enroll because there is equal opportunity to enter".

From 62.1 to 65.9% perceive as very characteristic of the University that "career provided by del Valle University are excellent".

And, between 62 and 66% consider as very characteristic of the University that "demanding level to enroll del Valle University is high"

Discussion of results

A general method is proposed to design a sampling plan which purpose is to approach measurement of image perception about any higher education institution, among students of the last grade of H.S. education.

First, population within the area of influence of the higher education institution is defined, and cities considered as of higher presence of students within such area of influence are selected. It is assumed that the measurement instrument has already been prepared and approved, and that the next stage is to apply such instrument to grade-11 students on individual basis. The goal is then, to select a sample of those students taking grade 11 at schools located within the cities in the area of influence.

A list of schools in each city is available, but no data on the number of students at each school. Within this scenary, we appealed to information which could provide an idea on population size. In this case, a list of students having taken state tests in 2008 was used.

Another important aspect in this type of samples, is to include in the sample students of every education modes. Therefore, four dominions at each city were defined, in order to include students from state and non-state schools, and schools awarding diploma of academic high school, or diploma in other modes (technical, commercial, etc.)

In preparing the sample, an original sampling size of education institutions is selected, parting from the assumption that the main variable will be the proportion of grade-11 students, who consider as very characteristic of del Valle University, this statement: “careers provided by del Valle Univesity are the ones that the region and the country need” (answers 6 and 7 of the measurement scale). It is assumed that this proportion could be near 0,5 and this value is used, which is associated to the maximum variance of the estimator, to propose a number of ecucation institutions to be included in the sample.

The following steps imply distributing this number of schools among the cities, and among defined dominions within the cities, to, finally, select the schools, on aleatory basis, and access each school, and survey all studens of the first group in grade 11.

This procedure was followed in del Valle University area of influence, in the Colombian Southwestern, including ten cities in the states of Risaralda, Quindio, Valle del Cauca, Cauca and Nariño; 4,050 grade-11 students of schools of Cali, Armenia, Buenaventura, Buga, Palmira, Pasto, Pereira, Popayan, Santander de Quilichao, and Tulua were interviewed, including the sample of all cities and dominios within each city on proportional basis.

The necessary expressions to perform the formal process of estimation are re-

ported, and applied to the case of del Valle University.

Although the investigation project included questions to various object groups, for example, parents, students from other universities, etc., this sampling plan was designed and applied for grade-11 student population.

Results of such application highlight advantage of the proposed methodology, therefore the authors recommend using this analytical strategy in similar cases.

Conclusions

Sampling design proposed in this work, allows to achieve highly reliable data, avoiding at the maximum extent any slants on selection.

For grade-11 student population, it is proposed to use an aleatory sampling plan by clusters, considering that they are forming groups, and the easiest and practical way to approach them is by means of a selection as a group. Since each group belongs to an education institution, taken on the listing basis (sampling frameworks) of such institutions provided by secretary of education offices, selection of any of them leads to select a group of students within such education institution.

In order to obtain global indicators (which involve all del Valle University influence area) regarding grade-11 students, it is necessary to establish weighting by city, because of diversity among them, according to the number of schools, or grade-11 students.

In the executed sampling model it is determined the sample size based on estimation of population proportion, assuming confidence levels of 95%, and sampling error lower than 10%

Organization of field work for data collection is easier by proceeding in this manner.

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