

## **Multiple Spatial Representations of Underrepresented Indigenous Lands and Oral based Knowledge of Sustainable Practices.**

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The customary indigenous practices in land use among the Mayans are expressed in the concept of communal land, which coexists with the concept of individual property (Carrera, 2000: 22). In Guatemala, the proposed constitutional reforms of 1998 included, in article 70, the recognition of the customary law, but this did not pass in the Congress (Palma, Taracena and Aylwin, 2002). The Guatemalan Peace Agreements that were signed on December 19, 1996, included rights relating to indigenous land, such as communal land and land tenure. “Communal or collective and the individual tenure of land, rights of ownership and possession and other real rights, and the use of natural resources for the benefit of the communities without detriment to their habitat, (...) measures to regularize the legal situation with regard to the communal possession of lands by communities which do not have the title deeds to those lands, including measures to award title to municipal or national lands with a clear communal tradition. To that end, an inventory of the land tenure situation shall be drawn up in each municipality” (United Nations, 1998: 77-78).

Significant Peace Agreement commitments regarding land registry, indigenous land rights, and law were not implemented, among them the customary law stating that “development of land register, the incorporation of customary law within the legal system, legislation about indigenous people’s right to land, revision of the existing legislation in order to abolish any laws or provisions that may have discriminatory implications for the indigenous population indigenous land” (Salvesen, 2002: 14-15). Moreover, José Aylwin, in a significant study of the indigenous access to land in Latin America, mentions that there is lack of specific regulation of indigenous lands and, in the Guatemalan case, the current legal system of lands is applied without distinction to landless indigenous peasants and non-indigenous peasants. He added that the Guatemalan property registry is very old and does not have updated cadastral information of indigenous lands; the output includes multiple titling of the same parcel and land disputes. Thus there is a need to replace the current system with a new technology, and this should occur prior to land fund programs (Aylwin, 2002: 74). Meanwhile, a proposed cadastral law that was submitted to the Congress in 2001 has not passed yet. This proposed Cadastral Law was written

by the Commission of the Indigenous Communities' Rights of Land (Comisión Paritaria sobre Derechos Relativos de los Pueblos Indígenas) which has representatives from government and from the indigenous community. The Proposal includes among its reasons that “the absence of a law that allows to define with precision, the location, area and shape of parcels according to the rights has produced the taking of lands affecting small rural producers and indigenous communities, governmental and municipal lands, and it has fomented the concentration of land” (Comisión Paritaria, 2001). According to the cadastral law proposal, the lack of legal certainty of property has produced an informal land market, which increases the vulnerability of small and middle land possessors and tenants. This lack of certainty of property ownership prevents use of lands as productive entities for credit and economic system. The law project proposes the creation of a Cadastral Information Registry that, in coordination with the Property Registry, would become a legal foundation for national development. The law project also considers a national information system of registry-cadaster which contains national data about land parcels and legal changes.

Land surveying and measuring is one of the legal conditions of the land dispute resolution, but there is indigenous resistance to accepting it because it contradicts the customary indigenous practices regarding the land. Earlier survey attempts in 1995 and 1998 stopped the negotiation process in Chajul since communities defended their land after showing that the court did not have the title. In this case, the government transferred the Chiules to different land without asking them to resign their land rights in the Cimientos area (Durocher, 2002: 126). The lack of registry of land and transactions has transformed the real practices of inheritance and possession rights of occupants of vacant and communal lands into social contract and customary law. But social contracts are not valid outside of the towns that have a local acceptance of them. Hernando De Soto indicated that the limitation of the social contracts is that they are meaningless to other groups: “The problem with extralegal social contracts is that their property representations are not sufficiently codified and fungible to have a broad range of application outside their own geographical parameters. Extralegal property systems are stable and meaningful for those who are part of the group, but they do operate at lower systemic levels and do not have representations that allow them to interact easily among each other” (De Soto, 2000: 180). Social contracts are limited in their ability to represent land property as capital assets. However, legal contracts also have problems, namely the lack of participation by peasants and indigenous people

in governmental land programs and the spatial decision making and transactions related to dispute resolution.

One important component to consider in the Guatemalan future property systems is the customary practices that have an impact on sustainable management. It has been written that the security of land tenancy of communal landholdings can be the basis for collective action in the long-term application of more sustainable management of land resources. Tenure security is important because the benefits of sustainable technologies require a long time to be realized in plantations; consequently the lack of tenure security would imply the implementation of short-term technologies that are less sustainable (Knox, 1998). Tenure security is also important for land market because there are three kinds of land rights -property, possession and use- which determine the dynamics of the land market (Carrera, 2000).

In addition, it has been mentioned that communal property rights are important to incentive efficient land use and investment and facilitate transactions in markets because property rights allow more capital flow by reducing asymmetric information between members of the same community and non-members of the community regarding ownership and parcel location. “As the mobility of individuals and capital increase (...) more and more transactions take place with outsiders of the community resulting in problems of imperfect information and, therefore, land disputes” (Vogelgesang, 1998: 5).

Communal property rights are also significant for rural development planning and it is believed that social capital can substitute for legal property rights. A researcher reports regarding the social capital interaction with land tenure and natural resource management in Petén and the Highlands that ejidos are land that municipalities rent to residents and may include public forest reserve. In Peten, the researcher’s findings are that “municipalities are unaware of location, extension, boundaries, or number of ejidatarios using municipal lands” (Katz, 2000: 119). Katz pointed out in regards to communal land in the Highlands that “ both smallholder agricultural lands and common property forests suffer from a lack of formal property rights in the form of a legally registered title. (...) However, ..., traditional boundaries are generally respected, (...) and tenure insecurity is not the principal cause of unsustainable natural resource management practices, where social capital has been more successfully maintained, (there are) most successful examples of natural resource conservation” (Katz, 2000: 121).

It is been mentioned regarding the recognition of communal rights that they “protect culture, internal decision-making, and, in particular, control and use of land (...) recognition is indispensable in order to effectuate a workable system of protection of indigenous traditions and ways of life” (Wiessner, 1999: 122). Furthermore, one community that has been studied settled for over a century in an Eastern biosphere reserve of Guatemala, where the community has dependence on the forest’s value and scarcity of land, and settlers respect transactions of trade, rent, or allocation, despite the fact that the land is all either owned by the municipality or by absentee landlords. Then “the rights to work in these plots, though not legal, are recognized by the community members and can be inherited, sold and rented” (Gibson, 2000: 7). In addition, another author reported that Itzaes indigenous peasants have a forest model of reciprocal interaction between animals, plants and humans, with agricultural practices of recycling of nutrients and maintenance of forest biodiversity that are more sustainable as compared to those of the non-indigenous migrant peasants in Petén, Guatemala. According to Atran and Medin, indigenous “see a long-term relationship between forest and community as a contract of mutual assistance, which individuals today may or may not ‘freely’ choose to follow” (Atran and Medin, 1997: 194, 198). Another author mentioned that property rights and land tenure on natural resource use are significant to identify “desirable allocation of resources, leading to long term sustainable practices” (Lumley, 2002: 20).

Moreover, twenty K’iche’s communities of Totonicapán still have pre-colonial territorial organization of familiar lineage to use and protect their ancestral patrimony, and their customary rules are successful to preserve the forest with the highest population density in the country (Lopez and Catanhede, 2003: 10). Those practices are transmitted orally and divided by gender and age, so that women and children have popular knowledge, access and control of certain and natural resources of the forest that are related to medicine, water, firewood, and the men have access to the soil and vegetation; for instance, the men and women have different conception of their responsibilities and the utilities of forest resources and soil (Lopez and Catanhede, 2003).

Then, representation of lands is meaningful because land tenure can be significant to the allocation of the land supply for more sustainable agricultural practices, and the irrigation of low lands. The potential of sustainable practices for biodiversity is remarkably important because Guatemala has a large indigenous population that has been more than forty-percent of the total population for the last forty years. In the percentage of population that indigenous is more than

more than 80%, according to the 1994 Guatemalan Census. Guatemala has a historical reclassification of some communal lands into private and municipal or national governmental lands. Land tenure categories were introduced with the governmental colonization lands sold to cooperatives with collective ownership, and the lease of protected lands to peasant organizations. Interestingly, some communal lands originated in pre-hispanic period still exist, and in some cases they coexist with governmental administration of lands. In addition, this chapter evidenced the importance indigenous knowledge to manage land sources. Thus, securing communal land tenure is meaningful for the sustainable land uses and conservation of environmental resources. The oral representation and descriptions are very relevant for a system of land dispute resolution and land use management because the transmission and dissemination of traditional knowledge and land tenure is verbal among the indigenous and illiterate people. The multiple categories of land tenure are complex to represent because they have overlapping land boundaries and uses. Indigenous people had represented those communal tenure categories orally. Conventional maps have represented graphically the governmental and private land tenure that overlapped some communal lands. This process of reclassification of land tenures that overlapped with former land tenures has resulted in different oral and map representation of communal, private, vacant and state lands among indigenous people and non-indigenous people. These differences between map and oral representation are illustrated and discussed in this essay.

This essay is based on the results of a doctoral dissertation survey concerning geographic and spatial features of Spanish-speaking subjects in Guatemala. The survey was also answered by an additional group of 100 bilingual students, 50 whose first language is a Mayan Quiche, and 50 Cackchiquel subjects whose secondary language is Spanish. Those who do not speak a Mayan language live in urban areas surrounding Guatemala City, and those who speak a native language live in urban or rural areas in Quiche and Chimaltenango, where they speak Quiche and Cackchiquel respectively. Two sample z-tests are performed to compare sample means. The z test results shows whether the variances of the two samples can be equal. The significance level is for values between 1.96 and -1.96.

This essay focuses on the differences that bilingual-indigenous and Spanish-speaking subjects showed in the survey. The purpose of the survey is to provide input to establish the quality of the representation and legibility of spatial features in maps as compared with oral and written descriptions, such as those used in titles of property. For example, the indigenous

subjects answered that oral and written descriptions are more legible than conventional maps. In addition, the representation of borders and limits is insufficiently legible in maps and written descriptions of titles of properties. Survey results show that oral and written descriptions of some features are more legible than conventional maps. The survey showed that both subject groups do not agree about what is represented in a map downloaded from the IGN Web page (Guatemalan national mapping agency Web page), even though the map used in the survey is the same for all subjects. This disagreement is an example of what would happen to native populations in different areas of the Guatemalan country, where population groups with the same level of education can have different understandings of what is represented in maps. Conventional maps can take advantage of other options to portray or describe geographic and spatial information, such as oral knowledge and written descriptions.

### **1.1. Legibility of spatial and geographic representations**

The survey used legibility as one indicator of the performance of maps and photographs of geographic features representing geographic concepts. The subjects believe that a photograph of persons is not a good indicator to establish a territory or a property. The following illustrations (1 to 4) were part of the questionnaire. The question to one group was *How good are the following photos as examples of property?* The question to another group was *How good are the following photos as examples of territory?*

The options to respond were: 1, if the photos were an excellent example; 2, if the photographs were a fair example; and 3, if the photographs were a bad example of “propiedad” (property) or “territorio” (territory).

The Spanish-speaking subjects answered that a photograph of an outdoor public market crowded with persons is a bad example of property and a bad example of territory. The mean was 2.37 for the performance of the photographs as an example of territory and 2.23 for the photographs as an example of property. The bilingual indigenous subjects answered that the crowded market is a bad example of property reflected in the mean of 2.26, and a bad example of territory as shown in the mean of 2.33. Therefore, Spanish-speaking and indigenous subjects agree that photographs of crowded areas are bad examples of property and territory.

In addition, Spanish-speaking subjects did not find a map of the country with its departmental division (states) an excellent example of territory since the mean was 1.78, even

though it is a good example. Another group of Spanish-speaking subjects answered that the same map is a good example of property since the mean of answers was 1.98, although the answers showed that the best example of territory is the map as compared to the photographs. The indigenous subjects answered that the map of Guatemala is near to a good example of property, as indicated in a mean of 2.08, and it is a good example of territory with a mean of 1.73.

Moreover, the Spanish-speaking subjects answered that a photograph of a sugar plantation in a valley is not a good example of territory, and the same photograph showed better performance as an example of property. The answers concerning the sugar cane plantation had a mean of 2.32 for territory, and a mean of 1.88 for property. This photograph had the best performance as an example of property among the other photograph and the map. Indigenous subjects answered that a sugar cane plantation photograph is a good example of property with a mean of 2.00; for them it is also good example of territory with a mean of 1.90. Regarding territory, there is a difference between Spanish and bilingual-indigenous subjects; for the indigenous it is a better example of territory than it is for the Spanish speakers.

In addition, the Spanish-speaking subjects answered that the photograph of a traditional bridge in the Magdalena River in the town of Amatitlán is not a good example of territory. In this case, the bridge is a better representation of property than territory. The mean of the subjects' answers is 2.31 for territory, and 2.00 for property. The bilingual indigenous subjects answered that the same photo of the bridge is a good example of property with a mean of 2.04; and for them it is a good example of territory. This is another difference between Spanish speaking and bilingual indigenous subjects; for the indigenous the bridge is a better example of territory than it is for the Spanish speaking population.

Comparing all the indicators, in summary, photographs and maps are not the best examples of property or territory since the mean of subjects' answers was not quite 1. Yet, among these photographs, a map showed a better performance as example of territory, and the photograph of a plantation showed an even better performance as an example of territory.

Table 1 has a summary of the means. To both Spanish speaking and bilingual- indigenous subjects, the map is a good example of property and territory, and the crowded public market is a bad example of property and territory. There is sensitivity of representation between the Spanish-speaking and bilingual indigenous; this sensitivity is indicated in the representation of property and territory of plantations and infrastructure. For the indigenous, a plantation and a bridge can

be legible representations of territory and property, although the results show that representation still can be improved. However, for Spanish speaking subjects, the plantation and the bridge are good representations of property, but they are bad representations of territory.

In this case, the results suggest that using the same representation will have different meaning for both groups. The difference is that fiat and bona fide features need different representations. Territory is perhaps a more abstract concept for the Spanish-speaking population than it is for indigenous subjects. Property is, for the indigenous, a very specific category that can not be easily represented with only maps and photographs. Perhaps a textual description is useful, and it will be suggested in the following pages as indicated in the results of a question that compares maps with oral and written descriptions. Although the groups are Guatemalan, the results imply that it is necessary to calibrate the representations according to the groups. This is illustrated by Table 1, Table 2 and Chart 1, which compare mean of answers for the non indigenous sample, Chart 2, which contains the results for the sample of the bilingual population that speaks indigenous languages and Spanish. Z values show that means are significant.

Table 1 Images in survey representing territory and property





|   |  |
|---|--|
|  |   |
| <p>Photograph 1 by M. Chacon (6-2002)<br/>crowded outdoor public market</p>         | <p>Map 1 Guatemala</p>   |
|  |  |
| <p>Photograph 2 by M. Chacon (6-2002)<br/>"La Gloria" Bridge in Amatitlán Town</p>  | <p>Photograph 3 by M. Chacon (6-2002)<br/>Sugar cane plantation</p>                  |



Table 2 Comparing Representations of Property and Territory

| Property |           |       | Territory |           |      | Example                                  |
|----------|-----------|-------|-----------|-----------|------|--|
| Spanish  | Bilingual | z     | Spanish   | Bilingual | z    |  |
| 1.88     | 2.00      | -0.66 | 2.32      | 1.90      | 3.11 | Sugar cane plantation photograph         |
| 2.23     | 2.26      | -0.19 | 2.37      | 2.33      | 0.32 | People in public market plaza photograph |
| 1.98     | 2.08      | -0.53 | 1.79      | 1.73      | 0.50 | Map of Guatemala                         |
| 2.00     | 2.04      | -0.24 | 2.31      | 2.00      | 2.55 | Bridge Gloria Amatitlán photograph       |

1= excellent, 2= fair, 3= bad example. Highlighted rows are critical values

Z critic=1.96 and -1.96,  $\alpha=0.025$ , 95% confidence interval

## 1.2 Performance of maps

The survey included a question about the performance of maps and information according to legibility, usefulness, user satisfaction and accessibility. Legibility evaluated characteristics of the information in maps, such as color, numerical data, symbols, text, and distances. Usefulness of maps was evaluated in relation to the needs of the users in terms of clarity, updated data, and level of truth. Accessibility was evaluated according to convenience of the location of the site where maps are distributed, the affordability of maps (price), and the availability of public transportation supply. The options for answers were, 1 (agree), 2 (cannot answer), and 3 (disagree). Z values show that means are significant.

Table 3 shows that the critical results are for the variable of usefulness, since the mean of the indicators is greater than 2. For Spanish-speaking subjects, a mean of 2.23 showed that the most critical issue is the updatability of maps, followed by the availability of maps, which had a mean of 2.08. For the indigenous bilingual subjects, the information they need is not satisfactorily clear, as indicated by a mean of 2.14; in contrast to the Spanish-speaking population, clarity is not an issue. For the indigenous-bilingual subjects, the availability and updatability of information they need is not satisfactory as indicated by means of 2.03 and 2.22.

Moreover, Table 3 also shows that accessibility is critical for the Spanish-speaking population due to response to the location of the center of distribution, which has a mean of 2.06. The accessibility is not a critical issue for the indigenous population, although the location center has a less than satisfactory response from the subjects. Response to legibility is not very negative, but the mean of the legibility is greater than 1.5, which means that the legibility can be improved. In addition, the legibility is less satisfactory for the indigenous subjects, as shown by Table 3. Even though, the means are below 2, they are still greater than the means for the Spanish-speaking subjects.

The concern comes from the big difference in the legibility of numerical data, symbols, text and distance. For the indigenous subjects, the size of maps is not good, as shown by a mean

| Indicator | Mean Guatemalan Spanish | Mean bilingual indigenous | Z Test | Performance of maps                       |
|-----------|-------------------------|---------------------------|--------|---|
| Legibi    | 1.56                    | 1.59                      | -0.17  | Lines shown in maps are legible and clear |
|           | 1.58                    | 1.94                      | -2.00  | Numerical data are legible and clear      |
|           | 1.59                    | 1.97                      | -2.03  | Symbols of maps are legible and clear     |

of 2.08. Interestingly, colors are clearer for the indigenous subjects than they are for Spanish-speaking subjects. The differences are illustrated by Chart 3, and it can be observed that the map performance is better for the Spanish-speaking than for the indigenous bilingual subjects, since all factors but the color are more satisfactory for the Spanish-speaking subjects. Chart 3 also shows a summary of the results of performance of maps for both Spanish and bilingual indigenous subjects. The lines, numerical data and symbols show better performance as far as legibility. In contrast, the text, distances and sizes of maps have shown that they are less legible than the lines and numerical data.

Table 3 Performance of Maps for Spanish and Bilingual-indigenous Samples

1 (agree), 2 (cannot answer), and 3 (disagree)  
 Z critic=1.96 and -1.96,  $\alpha=0.025$ , 95% confidence interval

|               |      |      |       |   |
|---------------|------|------|-------|---|
|               | 1.63 | 1.49 | 0.82  | Colors of maps are clear  |
|               | 1.65 | 1.81 | -0.84 | Text of maps is legible and clear   |
|               | 1.73 | 1.86 | -0.71 | Distances represented in maps are clear   |
|               | 1.76 | 2.08 | -1.75 | Size of maps is according to the contents   |
| Accessibility | 1.88 | 1.66 | 1.29  | There is enough public transportation available to the center of distribution of maps |
|               | 2.06 | 1.81 | 1.42  | Location of center of distribution of the maps is convenient                          |
|               | 1.58 | 1.77 | -1.21 | Price of maps is affordable   |
| Usefulness    | 1.90 | 2.14 | -1.23 | Information that you need is clear in maps  |
|               | 1.98 | 1.86 | 0.65  | Information that you need is truthful in maps   |
|               | 2.08 | 2.03 | 0.26  | Information that you need is available in maps  |
|               | 2.23 | 2.22 | 0.05  | Information that you need is updated in maps  |

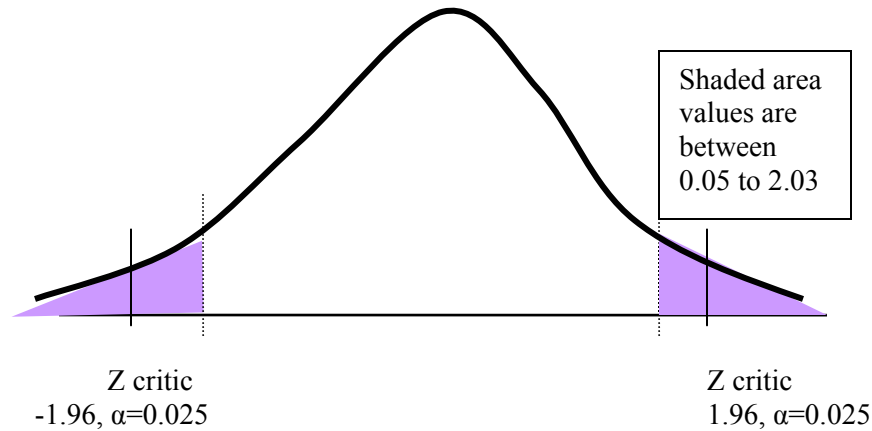


Figure 1 Z Distribution

### 1.3. Comprehension of maps by media of portrayal

An additional question was asked to the Guatemalan-Spanish and bilingual-indigenous subjects in order to compare the learning and comprehension derived from paper maps with that of computerized maps portrayed on a monitor.

The question has a list of specific geographic and spatial features that subjects would find represented on a paper printed map and on a computerized map on a monitor. The purpose of the question is to establish which items are easier to understand if they were hypothetically portrayed on paper or a computer monitor. The rank scale is 1 if the comprehension and learning are excellent, 2 if they fair, and 3 if they are bad.

Table 4 shows that Spanish-speaking subjects find more satisfactory comprehension in monitor maps as compared with paper maps. This is indicated by means above 2 in several items that have local scale, such as buildings, a city, village, street, car, parks, land parcels, and a house. The Spanish-speaking find more satisfaction in learning derived from maps portrayed on a monitor. Volcanoes, rivers and lakes portrayed on paper maps still yield satisfactory comprehension. Table 4 shows that bilingual indigenous speaking subjects find maps more satisfactory than the Spanish speaking population does, as indicated by lower means between 1.8 and 2.0. A highway is a point of critical concern, since it has a mean of 2.05 for Spanish speaking and 2.13 for bilingual indigenous subjects. Although the Spanish-speaking seem to be satisfied with the learning derived from printed maps, they are even more satisfied with maps portrayed by monitor. For example, parks, volcanoes, and villages shown much better learning on a monitor than on paper maps. Z values show that means are significant.

Table 4 Comparing learning comprehension from paper maps versus computer monitor

| Spanish |         | Indigenous |         | Spanish/Indigenous |                | Feature           |              |
|---------|---------|------------|---------|--------------------|----------------|-------------------|--------------|
| Paper   | Monitor | Paper      | Monitor | Paper Z test       | Monitor Z test | Spanish           | English      |
| 2.05    | 1.79    | 2.13       | 1.76    | -0.37              | -0.06          | Carretera         | Highway      |
| 2.00    | 1.61    | 1.93       | 1.59    | 0.74               | 0.08           | Población         | Population   |
| 1.95    | 1.57    | 2.00       | 1.65    | -0.36              | -0.22          | Montaña           | Mountain     |
| 2.28    | 1.74    | 1.67       | 1.38    | 3.69               | 2.60           | Parques           | Parks        |
| 1.88    | 1.59    | 1.79       | 1.50    | 0.68               | 0.74           | Volcan            | Volcano      |
| 1.76    | 1.62    | 1.60       | 1.60    | 1.17               | 0.15           | Río               | River        |
| 2.15    | 1.83    | 1.71       | 1.86    | 3.36               | -0.47          | Arboles           | Trees        |
| 1.76    | 1.69    | 1.87       | 1.56    | -1.17              | 0.57           | Lago              | Lake         |
| 2.24    | 1.79    | 1.73       | 1.50    | 4.91               | 2.06           | Edificios         | Buildings    |
| 2.08    | 1.59    | 1.83       | 1.72    | 2.21               | -0.81          | Ciudad            | City         |
| 2.08    | 1.71    | 1.75       | 1.60    | 2.07               | 0.94           | Aldea             | Village      |
| 2.05    | 1.70    | 1.77       | 1.47    | 1.53               | 1.67           | Calle             | Street       |
| 2.29    | 1.76    | 1.85       | 1.88    | 3.41               | -0.91          | Vehículos         | Cars         |
| 2.05    | 1.71    | 1.94       | 1.93    | 0.90               | -1.18          | Parcela de tierra | Land parcels |
| 2.03    | 1.71    | 1.86       | 1.65    | 1.05               | 0.80           | Viviendas         | House        |

1= excellent comprehension, 2= fair comprehension, 3= bad comprehension  
 Z critic=1.96,  $\alpha=0.025$ , 95% confidence interval

Thus, learning and comprehension derived from a printed map can be different for subjects from the same country and with the same level of education. Chart 4 shows that overall, the monitor map provides more satisfactory learning in indigenous subjects than in Spanish-speaking ones; it also shows that paper maps are still satisfactory for the indigenous, while the paper maps are not satisfactory for the Spanish-speaking population, although they experience satisfactory learning of large scale features on printed maps.

The null hypothesis is that both samples have similar means and normal t-distribution. The z test results shows whether the variances of the two samples can be equal. The significance level is for values between 1.96 and -1.96. Most of the examples have significant differences. In contrast, “parques,” and “edificios,” have more than 1.96 values for both samples. A larger sample is needed to show statistical differences in these examples. Also both samples may have different conception of a “park.”

#### **1.4. Performance of maps as compared to oral and written descriptions**

In addition, the survey included a question regarding the performance of maps as compared with oral and written description. This particular question included specific geographical and spatial features. The question was: *How would you evaluate the clarity of the following examples if they were shown in a map, or through written or oral-written descriptions?* The same geographical features were examples for both options (map or oral-written descriptions) and to Spanish and bilingual indigenous subjects. The options to answer were 1 (excellent), 2 (fair), 3 (bad).

##### **1.4.1. Spanish-speaking subjects**

As Table 5 shows, for Spanish speaking subjects the map had better performance representing some features, but it also had the worst performance in representing other features. In contrast, the oral and written descriptions show a better performance compared to the maps, although for some features, the maps have better performance. Maps had means between 1.5 and 2.4, and oral-written descriptions had means between 1.7 and 2.2.

As shown in Table 5, Spanish subject answers had a mean of 1.5 when maps show large scale things such as mountains, volcanoes, highways, capital cities, countries, lakes, rivers and lands. In contrast, oral-written descriptions have the best performance with a 1.7 mean for representing abstract territorial concepts and general categories such as population, country, animals, municipality and capital city. Maps are better at representing more specific categories such as districts and borders, according to their 1.7 mean. The oral and written descriptions had a mean of 1.9 for the same features (districts and borders).

The oral-written descriptions are almost as good as maps for showing land, according to their means of 1.8 and 1.7, respectively. The oral and written descriptions are also as good as maps for showing a capital city, with means of 1.7 and 1.6, respectively. However, they still could improve to a level 1.

Although it is still good, the lower performance of oral-written description has means between 2.00 and 2.2 for representing specific territorial categories such as land parcels, highways, and bridges. The mean between 2.2 and 2.4 shows maps as the worst performers in the representation of abstract concepts and general territorial categories such as sky, population, and municipality. Subject results had a mean of 2.1 or 2.2 for maps' representation of social

constituencies and territories such as neighborhoods, community, field, plantations, trees, and marginal resettlement.

In addition, the oral-written descriptions show poorer performance as the features become more specific in territorial scale and categorization. Subject results had a mean of 1.9 for oral and written descriptions of village, beach, church, marginal resettlement, river, state, districts, city, and valley.

For the Spanish-speaking population, oral-written descriptions show a 1.8 mean for a better performance in representing urban features of collective or social constituency such as county, neighborhood, a public market, a community, a school, and houses. Oral-written descriptions show a good performance in representing regional to local-scale territories such as a field, a tree, plantations, volcano, school, houses, sky, mountain, or lake.

For Spanish-speaking subjects, maps have a tendency to improve their performance in representing more specific territorial categories and less abstract concepts. Maps had a mean of 1.8 and 1.9 when representing community, valley, and village. Maps had a mean of 2 for representing church, beach, animals, forest, market, and land parcel. Maps had a mean of 2.1 when representing fields, plantations, trees, marginal resettlements, school, bridge, park, and houses.

Table 5 Oral & written descriptions versus maps for Spanish-speaking subjects

| Rank | mean | Scale * | Oral-Written Descriptions                | Scale * | mean | Maps                                    |
|------|------|---------|--|---------|------|---|
| 1    | 1.70 | 4       | Población (population)                   | 3       | 1.50 | Mountain (mountain)                     |
| 2    | 1.70 | 4       | País (country)                           | 3       | 1.50 | Municipio (county)                      |
| 3    | 1.70 | 4       | Ciudad capital (capital city)            | 2       | 1.50 | Volcan (volcano)                        |
| 4    | 1.70 | 4       | Animals (animals)                        | 4       | 1.60 | Departamento (State)                    |
| 5    | 1.70 | 4       | Municipalidad (municipality)             | 3       | 1.60 | Carretera (road)                        |
| 6    | 1.80 | 3       | Bosque (forest)                          | 3       | 1.60 | Ciudad capital (capital City)           |
| 7    | 1.80 | 3       | Lago (Lake)                              | 2       | 1.60 | País (country)                          |
| 8    | 1.80 | 3       | Montaña (mountain)                       | 2       | 1.60 | Lago (lake)                             |
| 9    | 1.80 | 3       | Cielo (sky)                              | 2       | 1.60 | Ciudad (city)                           |
| 10   | 1.80 | 3       | Viviendas (houses)                       | 1       | 1.60 | Rio (river)                             |
| 11   | 1.80 | 3       | Escuela (school)                         | 2       | 1.70 | Tierra (land)                           |
| 12   | 1.80 | 2       | Volcán (volcano)                         | 2       | 1.70 | Zonas (districts)                       |
| 13   | 1.80 | 2       | Parque (park)                            | 2       | 1.70 | Frontera (border)                       |
| 14   | 1.80 | 2       | Tierra (land)                            | 2       | 1.80 | Puerto (port)                           |
| 15   | 1.80 | 2       | Comunidad (community)                    | 3       | 1.90 | Comunidad (community)                   |
| 16   | 1.80 | 2       | Plantaciones (plantations)               | 2       | 1.90 | Valle (valley)                          |
| 17   | 1.80 | 2       | Puerto (port)                            | 2       | 1.90 | Aldea (village)                         |
| 18   | 1.80 | 2       | Arbol (tree)                             |         | 2.00 | Iglesia (church)                        |
| 19   | 1.80 | 2       | Campo (field)                            | 3       | 2.00 | Playa (beach)                           |
| 20   | 1.80 | 2       | Mercado (market)                         | 3       | 2.00 | Animales (animals)                      |
| 21   | 1.80 | 2       | Vecindario (neighborhood)                | 2       | 2.00 | Bosque (forest)                         |
| 22   | 1.80 | 2       | Municipio (county)                       | 2       | 2.00 | Mercado (market)                        |
| 23   | 1.90 | 2       | Valle (valley)                           | 1       | 2.00 | parcela (land parcel)                   |
| 24   | 1.90 | 2       | Ciudad (City)                            | 1       | 2.10 | Vecindario (neighborhood)               |
| 25   | 1.90 | 2       | Zonas (districts)                        | 2       | 2.10 | Campo (field)                           |
| 26   | 1.90 | 2       | Departamento (State)                     | 2       | 2.10 | Plantaciones (plantations)              |
| 27   | 1.90 | 2       | Rio (river)                              | 2       | 2.10 | Arbol (tree)                            |
| 28   | 1.90 | 2       | Barrio marginal (marginal resettlement ) | 2       | 2.10 | Barrio marginal (marginal resettlement) |
| 29   | 1.90 | 2       | Iglesia (church)                         | 1       | 2.10 | Escuela (school)                        |
| 30   | 1.90 | 1       | Playa (beach)                            | 3       | 2.20 | Puente (bridge)                         |
| 31   | 1.90 | 1       | Aldea (village)                          | 2       | 2.20 | Parque (park)                           |
| 32   | 1.90 | 1       | Frontera (border)                        | 2       | 2.20 | Viviendas (houses)                      |
| 33   | 2.00 | 1       | Parcela de tierra (land parcel)          | 4       | 2.20 | Municipalidad (municipality)            |
| 34   | 2.00 | 1       | Carretera (road)                         | 4       | 2.30 | Poblacion (population)                  |
| 35   | 2.20 | 1       | Puente (bridge)                          | 4       | 2.40 | Cielo (sky)                             |

Question: How is the clarity of the following examples if they were shown in a map, or if they were shown in written or oral descriptions? The same examples for both maps and oral-written descriptions. The options for answering were: 1=excellent, 2=fair, 3= bad

\*Scale of territorial Generalization and Abstraction: 4=general and social concepts, 3=natural concepts, 2= territorial, 1=physical objects. There is high performance in the map representation of large scale geographic features and in the oral representation of territorial categories and social constituencies such as neighborhood, municipality. Map representation has lower performance in small scale geographic features and spaces of collective uses such as districts, borders, sky, municipality. Oral descriptions have low performance in the case of infrastructure and social spaces, such as church, village, border, road and bridge. There is a difference showed between land as a general category and land parcel as specific object.

#### 1.4.2. Indigenous subjects

Table 6 shows interesting differences from the Spanish subjects. Initially, the indigenous subjects are more satisfied with the oral/written descriptions than the Spanish subjects, and they are also more satisfied with the maps than the Spanish subjects. They have means below 1.5 for oral-written descriptions and maps. In addition, they are less satisfied than the Spanish subjects with some items represented by the maps, such as Frontera (border), Valle (valley), Zonas (districts), parcela de tierra (land parcel), Campo (field), Aldea (village), barrio marginal (marginal settlement), Iglesia (church), Mercado (market), Municipalidad (municipality), and Vecindario (neighborhood). As shown by table 3.6 most of those items mentioned have a mean of 2.5, lower than the mean those items performed with the Spanish-speaking subjects in maps, as seen in Table 5. In contrast, Table 6 also shows that, for indigenous subjects, some items are better represented by maps, according to the mean, which is higher than the mean of items for Spanish subjects in table 3.5. For example, tree and houses have a mean higher than 2 for Spanish-speaking subjects, and they have a mean lower than 1.5 for indigenous subjects.

A very interesting difference is that representation of enclosure and enclosed spaces has different levels of satisfaction for the subjects. Table 5 shows that for Spanish-speaking subjects the land has means of 1.8 and 1.7, and for indigenous-speaking subjects in table 3.6 the land has a mean of 1.43 for oral-written description, and 2.00 for map. This means that for the indigenous language speaking population, oral knowledge and written descriptions are better representations of land. It is consistent with the land parcels, since the indigenous subjects' means are 1.71 for oral-written description and 2.20 for maps for the term land parcel. For Spanish-speaking subjects, both the oral-written descriptions and maps have a mean of 2.00 for the land parcel.

For Spanish-speaking subjects, the map has a mean of 2.0 for representing the term border, and the oral-written description mean is 1.9. For indigenous subjects, the map has a mean of 2.17 for representing border, and the oral-written description's mean is 2.00. Therefore, the representation of the border needs improvement for both groups in the maps and the oral-written descriptions. Table 7 has the z test of the sample means of Guatemalan-Spanish speaking and indigenous subjects. Z values show that means are significant. In addition, Charts 3.5 and 3.6 show the contrasts between Guatemalan Spanish-speaking and indigenous subjects in map and oral-written descriptions of geographic features. Chart 3.7 shows the contrasts between map and oral-written descriptions for the indigenous subjects.



Table 6 Oral and written descriptions versus maps for bilingual indigenous-speaking subjects

| rank | mean | Oral-written descriptions | mean | maps                            |
|------|------|---------------------------|------|---------------------------------|
| 1    | 1.33 | Ciudad                    | 1.25 | Animals (animals)               |
| 2    | 1.33 | Parquet                   | 1.25 | Arbol (tree)                    |
| 3    | 1.33 | Playa                     | 1.25 | Viviendas (houses)              |
| 4    | 1.40 | Volcan                    | 1.29 | Playa (beach)                   |
| 5    | 1.43 | Tierra                    | 1.29 | Volcán (volcano)                |
| 6    | 1.50 | Carretera                 | 1.40 | Bosque (forest)                 |
| 7    | 1.50 | Lago                      | 1.40 | Plantaciones (plantations)      |
| 8    | 1.50 | Puerto                    | 1.43 | Montaña (mountain)              |
| 9    | 1.50 | Valle                     | 1.43 | Rio (river)                     |
| 10   | 1.57 | Animals                   | 1.50 | Lago (Lake)                     |
| 11   | 1.57 | Arbol                     | 1.50 | Puente (bridge)                 |
| 12   | 1.60 | Montaña                   | 1.57 | Carretera (road)                |
| 13   | 1.60 | Rio                       | 1.60 | Ciudad (City)                   |
| 14   | 1.63 | Aldea                     | 1.67 | Ciudad capital (capital city)   |
| 15   | 1.63 | Cielo                     | 1.67 | Departamento (State)            |
| 16   | 1.63 | Escuela                   | 1.67 | Municipio (county)              |
| 17   | 1.63 | Mercado                   | 1.67 | País (country)                  |
| 18   | 1.63 | Municipalidad             | 1.71 | Puerto (port)                   |
| 19   | 1.67 | Zonas                     | 1.80 | Parque (park)                   |
| 20   | 1.71 | Parcela de tierra         | 2.00 | Cielo (sky)                     |
| 21   | 1.75 | Población                 | 2.00 | Comunidad (community)           |
| 22   | 1.80 | País                      | 2.00 | Escuela (school)                |
| 23   | 1.83 | Bosque                    | 2.00 | Población (population)          |
| 24   | 1.83 | Ciudad capital            | 2.00 | Tierra (land)                   |
| 25   | 1.83 | Puente                    | 2.17 | Frontera (border)               |
| 26   | 1.86 | Campo                     | 2.17 | Valle (valley)                  |
| 27   | 1.88 | Barrio marginal           | 2.17 | Zonas (districts)               |
| 28   | 1.88 | Comunidad                 | 2.20 | Parcela de tierra (land parcel) |
| 29   | 1.88 | Iglesia                   | 2.25 | Campo (field)                   |
| 30   | 1.88 | Vecindario                | 2.50 | Aldea (village)                 |
| 31   | 2.00 | Frontera                  | 2.50 | Barrio marginal                 |
| 32   | 2.00 | Plantaciones              | 2.50 | Iglesia (church)                |
| 33   | 2.00 | Viviendas                 | 2.50 | Mercado (market)                |
| 34   | 2.17 | Departamento              | 2.50 | Municipalidad (municipality)    |
| 35   | 2.17 | Municipio                 | 2.50 | Vecindario (neighborhood)       |

Question: How is the clarity of the following examples if they were shown in a map, or if they were shown in written or oral descriptions?

The same examples for both maps and oral-written descriptions.

The options for answer were: 1=excellent, 2=fair, 3= bad

Table 7 Two-sample test of means for clarity of maps versus oral-written description

| Guatemalan-Spanish |           |       | Indigenous        |           |       | Spanish versus Indigenous |                | Subjects                        |
|--------------------|-----------|-------|-------------------|-----------|-------|---------------------------|----------------|---------------------------------|
| Mean Oral-written  | Mean maps | Z     | Mean oral-written | Mean maps | Z     | Z map                     | Z Oral written | Feature                         |
| 1.90               | 1.90      | 0.00  | 1.63              | 2.50      | -1.03 | -1.88                     | 0.34           | Aldea (village)                 |
| 1.70               | 2.00      | -1.98 | 1.57              | 1.25      | 0.37  | 1.57                      | 0.18           | Animales (animals)              |
| 1.80               | 2.10      | -1.78 | 1.57              | 1.25      | 0.37  | 1.77                      | 0.31           | Arbol (tree)                    |
| 1.90               | 2.10      | -1.19 | 1.88              | 2.50      | -0.75 | -1.24                     | 0.03           | Barrio marginal                 |
| 1.80               | 2.00      | -1.20 | 1.83              | 1.40      | 0.51  | 1.07                      | -0.05          | Bosque (forest)                 |
| 1.80               | 2.10      | -1.81 | 1.86              | 2.25      | -0.48 | -0.36                     | -0.08          | Campo (field)                   |
| 2.00               | 1.60      | 2.63  | 1.50              | 1.57      | -0.08 | 0.04                      | 0.98           | Carretera (road)                |
| 1.80               | 2.40      | -3.47 | 1.63              | 2.00      | -0.43 | 1.10                      | 0.21           | Cielo (sky)                     |
| 1.90               | 1.60      | 1.95  | 1.33              | 1.60      | -0.32 | 0.00                      | 0.83           | Ciudad (city)                   |
| 1.70               | 1.60      | 0.65  | 1.83              | 1.67      | 0.18  | -0.11                     | -0.21          | Ciudad capital (capital City)   |
| 1.80               | 1.90      | -0.68 | 1.88              | 2.00      | -0.14 | -0.24                     | -0.10          | Comunidad (community)           |
| 1.90               | 1.60      | 2.09  | 2.17              | 1.67      | 0.59  | -0.11                     | -0.47          | Departamento (State)            |
| 1.80               | 2.10      | -1.84 | 1.63              | 2.00      | -0.42 | 0.24                      | 0.21           | Escuela (school)                |
| 1.90               | 1.70      | 1.20  | 2.00              | 2.17      | -0.20 | -0.81                     | -0.16          | Frontera (border)               |
| 1.90               | 2.00      | -0.57 | 1.88              | 2.50      | -0.75 | -1.55                     | 0.03           | Iglesia (church)                |
| 1.80               | 1.60      | 1.42  | 1.50              | 1.50      | 0.00  | 0.16                      | 0.45           | Lago (lake)                     |
| 1.80               | 2.00      | -1.18 | 1.63              | 2.50      | -1.03 | -1.55                     | 0.21           | Mercado (market)                |
| 1.80               | 1.50      | 2.00  | 1.6               | 1.43      | 0.19  | 0.10                      | 0.35           | Mountain (mountain)             |
| 1.70               | 2.20      | -3.26 | 1.63              | 2.50      | -1.03 | -0.95                     | 0.09           | Municipalidad (municipality)    |
| 1.80               | 1.50      | 1.98  | 2.17              | 1.67      | 0.59  | -0.26                     | -0.64          | Municipio (county)              |
| 1.70               | 1.60      | 0.66  | 1.8               | 1.67      | 0.15  | -0.11                     | -0.17          | Pais (country)                  |
| 2.00               | 2.00      | 0.00  | 1.71              | 2.20      | -0.57 | -0.40                     | 0.41           | Parcela de tierra (land parcel) |
| 1.80               | 2.20      | -2.40 | 1.33              | 1.80      | -0.55 | 0.73                      | 0.69           | Parque (park)                   |
| 1.80               | 2.10      | -1.73 | 2.00              | 1.40      | 0.82  | 1.24                      | -0.40          | Plantaciones (plantations)      |
| 1.90               | 2.00      | -0.64 | 1.33              | 1.29      | 0.04  | 0.96                      | 0.83           | Playa (beach)                   |
| 1.70               | 2.30      | -3.87 | 1.75              | 2.00      | -0.29 | 0.83                      | -0.06          | Poblacion (population)          |
| 2.20               | 2.20      | 0.00  | 1.83              | 1.50      | 0.37  | 1.04                      | 0.60           | Puente (bridge)                 |
| 1.80               | 1.80      | 0.00  | 1.50              | 1.71      | -0.24 | 0.13                      | 0.59           | Puerto (port)                   |
| 1.90               | 1.60      | 1.95  | 1.60              | 1.43      | 0.18  | 0.23                      | 0.52           | Rio (river)                     |
| 1.80               | 1.70      | 0.62  | 1.43              | 2.00      | -0.67 | -0.71                     | 0.49           | Tierra (land)                   |
| 1.90               | 1.90      | 0.00  | 1.50              | 2.17      | -0.77 | -0.46                     | 0.60           | Valle (valley)                  |
| 1.80               | 2.10      | -1.82 | 1.88              | 2.50      | -0.75 | -1.25                     | -0.10          | Vecindario (neighborhood)       |
| 1.80               | 2.20      | -2.60 | 2.00              | 1.25      | 0.91  | 2.00                      | -0.29          | Viviendas (houses)              |
| 1.80               | 1.50      | 2.21  | 1.40              | 1.29      | 0.12  | 0.28                      | 0.67           | Volcan (volcano)                |
| 1.90               | 1.70      | 1.22  | 1.67              | 2.17      | -0.59 | -0.81                     | 0.36           | Zonas (districts)               |

1=excellent, 2= fair, 3= bad. Z critic=1.96,  $\alpha=0.025$ , 95% confidence interval. In Spanish, “cielo,” and “departamento,” “municipalidad,” “población,” “viviendas” are showed low significance. They are some abstract concepts that need larger samples to be tested.

## **5. Performance of line-maps as compared to text in titles of property**

An additional question concerned the performance of representation of spatial features by map lines as compared to text in titles of property. The question was: *How well/highly do you evaluate the clarity of the following features if they were shown in maps as compared with their description in titles of property?* The answer options were: 1 (excellent), 2 (fair), and 3 (bad).

### **3.5.1. Spanish-speaking subjects**

Table 8 shows that lines are as good as text to represent the concept of territory since both have means of 1.6. The best performance of both is for representing territory. In contrast, the worst performance of both is for representing spatial limits or limits of spatial objects because both have a mean of 2.5, nearer to the option 3 of “bad.” Table 8 also shows that text of titles of property have means that suggest a better performance than lines in maps for representing the municipal borders, perimeters of a neighborhood, and property limits. The mean of texts is 1.8 for municipal borders, 1.9 for property limits, and 1.9 for neighborhood perimeters. In contrast, the lines in maps have means of 2.0 for municipal borders, 2.2 for property limits, and 2.3 for neighborhood perimeters.

In addition, Table 8 shows that line-maps are better than text of titles in representing the roads. Maps had a mean of 2.0, and texts of titles had a mean of 2.1. In contrast, line-maps are not as good as text-titles in representing paths and trails, according to their means of 2.4 (lines) and 2.1 (texts). Moreover, text in titles of property is a little better than line-maps in representing spatial endings, they had means of 2.3 (lines), and 2.2 (texts). Finally, the text in a title of property is better than line-maps for representing private possession and public property. The text had means of 1.9 and 1.7 respectively, and the line-maps had means of 2.3 and 2.1, respectively. As Chart 8 shows, in general terms, both lines in maps and text in titles of property performed poorly, but text of a title of property performed better than maps in representing concepts of private possession and public property, as well as representing linear spatial features such as roads and borders. Lines in maps have means between 1.6 and 2.5, and the text of titles has means between 1.6 and 2.5. It is crucial to recognize that maps need help from other sources to improve their performance in representing private possession and public property. Hence, both the lines and text need an improvement to increase their performance in representing critical landmarks, such as roads and spatial endings to solve conflict disputes.

### 1.5.2. Indigenous subjects

Table 8 shows that bilingual indigenous subjects have more satisfaction with line maps than text-titles of property in representing roads, municipal borders and national territory, since they have a mean lower than 2 for maps and higher than 2 for text-titles. Moreover, results suggest that text-titles are more satisfactory than maps for representing private possession, public property and paths and trails since the means for indigenous subjects for text-titles are 1.79, 1.67 and 1.92, respectively, and for maps the means are 2.20, 2.06 and 2.07 for private possession, public property and paths and trails, respectively. In contrast, Spanish-speaking subjects showed less satisfaction with maps and text-titles in representing public property and paths and trails. In addition, indigenous subjects also show dissatisfaction with the line-maps and text-titles in representing the spatial limits and the neighborhood perimeter. Table 8 showed that they have means greater than 2. Z values show that means are significant.

Table 8 Lines in Maps versus Text in titles of property

| Subjects                                      | Line-maps    |                      |        | Text-titles of property |                      |        |
|---|--------------|----------------------|--------|-------------------------|----------------------|--------|
|   | Spanish mean | Bilingual indigenous | Z test | Spanish                 | Bilingual indigenous | Z test |
| Caminos (roads)                               | 2.00         | 1.65                 | 1.90   | 2.10                    | 2.00                 | 0.47   |
| Frontera municipal (municipal border)         | 2.00         | 1.85                 | 1.00   | 1.80                    | 2.17                 | -1.78  |
| Limites de propiedad (property limits)        | 2.20         | 1.93                 | 1.51   | 1.90                    | 1.75                 | 0.71   |
| Orillas espaciales (shores or spatial limits) | 2.50         | 2.27                 | 1.39   | 2.50                    | 2.00                 | 2.27   |
| Perimetro del barrio (neighborhood perimeter) | 2.30         | 2.00                 | 1.63   | 1.90                    | 2.08                 | -0.77  |
| Posesión privada (private possession)         | 2.10         | 2.20                 | -0.48  | 1.70                    | 1.79                 | -0.43  |
| Propiedad publica (public property)           | 2.40         | 2.06                 | 1.68   | 2.00                    | 1.67                 | 1.43   |
| Senderos y brechas (paths and trails)         | 2.40         | 2.07                 | 1.58   | 2.10                    | 1.92                 | 0.83   |
| Territorio nacional (national territory)      | 1.60         | 1.72                 | -0.67  | 1.60                    | 2.15                 | -3.26  |
| Topes espaciales (spatial endings)            | 2.30         | 2.20                 | 0.48   | 2.20                    | 1.93                 | 1.13   |

Question: How good is the clarity of the following concepts if they were shown in maps as compared with their description in titles of property?

1= excellent, 2= fair, 3= bad; Z critic=1.96 and -1.96,  $\alpha=0.025$ , 95% confidence interval

The significance level is for values between 1.96 and -1.96. Most of the examples have significant differences. In contrast, the text-titles show low significance in “orillas espaciales,” and “territorio nacional,” then, they are very abstract concepts that need larger samples to show statistical differences.

## **1.6. Public User performance**

Another question of the survey is: What is represented in the following map? Map 2 is a map of Guatemala that included state and county divisions, as well as names of some states and highways. The options to answers were open. Subjects would want to answer what they found legible in the map 2. The goal of this question was to establish the level of understanding and the level of similarities of public users when they use maps.

Table 9 shows the first two ranks, as the subjects mostly saw the middle categories of state and counties as primary objects represented in the map. The greater frequency and mean is for states and counties. States had a mean of 1.3, while the counties had a mean of 2.2.

Furthermore, Table 9 also shows that the general category “country” ranked 12<sup>th</sup>, with a low frequency, although it had a high mean of 1.3. Following in rank, the subjects answered “villages,” which are a very specific category but were not included in the map.

It is interesting to realize that subjects answered the state capitals in the 3<sup>rd</sup> rank with a 2.6 mean, while they also answered in 4<sup>th</sup> rank with a 2.8 mean that they saw rivers. It is interesting because the map was not representing rivers or states’ capitals. Perhaps, the subjects interpreted that states had capitals, so if the states are there then their capitals must be there regardless of being represented or not on the map. Another reason could be that names of the states are also the same as their capitals in Guatemala. However, in 11<sup>th</sup> rank, with a mean of 1.3, the subjects answered the “names of states and counties.”

In the 5<sup>th</sup> rank with a 3.4 mean, the subjects answered the “geographic limits.” This is followed by highways in the 6<sup>th</sup> rank, with a mean of 3.1.

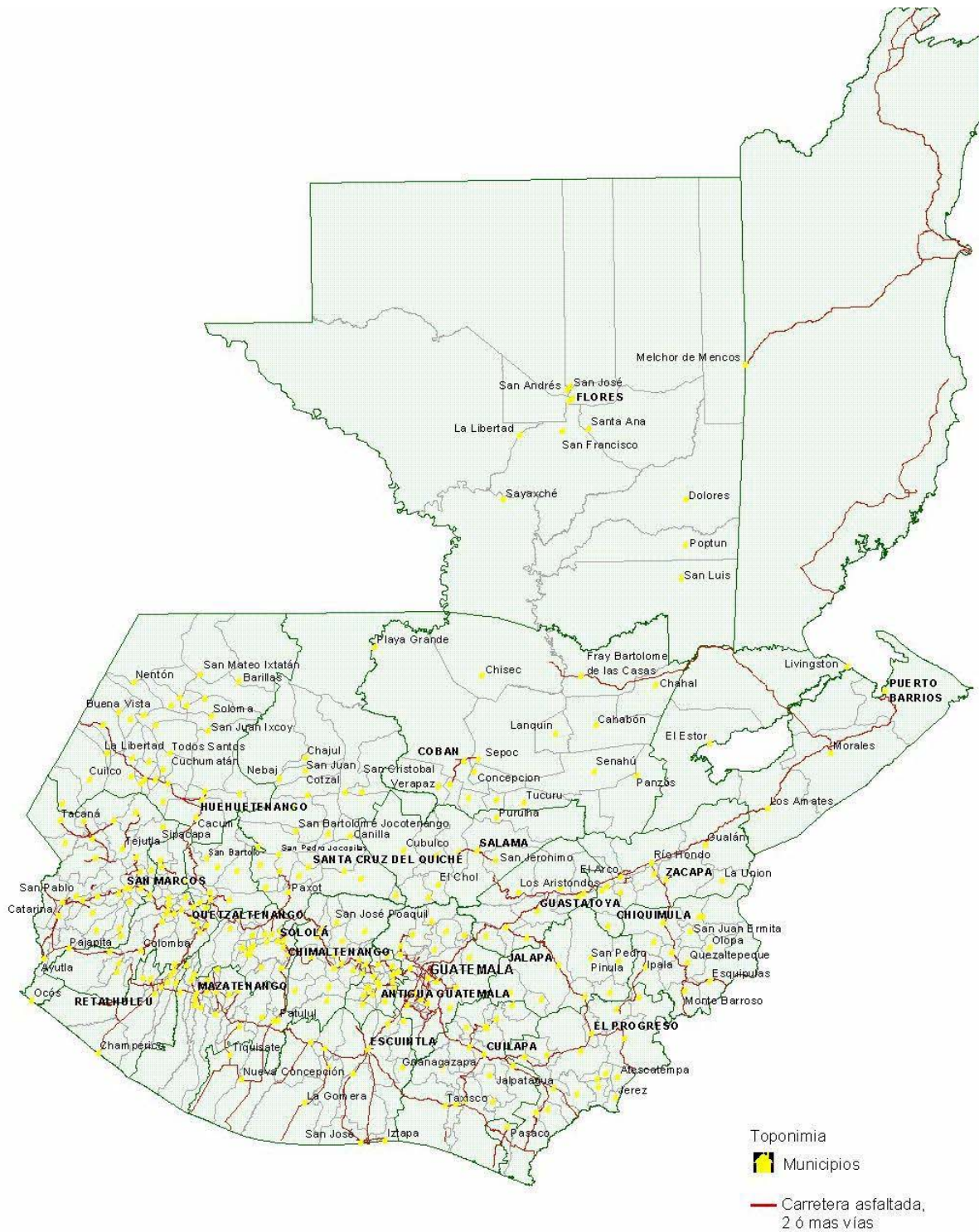
Another interesting result is the fact that subjects answered in the last ranks the territorial concepts which were drawn on the map, such as geographic division (rank 14<sup>th</sup>) and borders (rank 15<sup>th</sup>).

As a result, Table 9 shows that most public users first read and understand the territorial features that have middle categories. The largest or most general category contained in the map is not the main focus of the public. Then, subjects interpret that the map also represents the components of those middle categories, in this case the state capitals. Finally, the subjects read and find legible the abstract territorial concepts represented, such as borders. It is very interesting to find that in this map most of the subjects answered “rivers,” probably because they understood lines as rivers, though those lines were symbols of state borders and highways.

Table 9 What is Represented in the Following Map? For Spanish subjects

| Rank | N  | Mean | Feature  |
|------|----|------|--|
| 1    | 50 | 1.3  | Departamentos (states)                               |
| 2    | 41 | 2.2  | Municipios (counties)                                |
| 3    | 19 | 2.6  | Cabeceras departamentales (state capitals)           |
| 4    | 12 | 2.8  | Ríos (rivers)  |
| 5    | 11 | 3.4  | Límites geográficos (geographic limits)              |
| 6    | 9  | 3.1  | Carreteras (highways)                                |
| 7    | 5  | 3.2  | Límites (limits)                                     |
| 8    | 4  | 4.0  | Puertos (ports)                                      |
| 9    | 3  | 2.0  | Belice (Belize)                                      |
| 10   | 3  | 2.7  | División por departamentos (division per states)     |
| 11   | 3  | 1.3  | Departamentos y municipios (state and county' names) |
| 12   | 3  | 1.7  | País (country)                                       |
| 13   | 2  | 3.5  | Aldeas (villages)                                    |
| 14   | 2  | 3.0  | División geográfica (geographic division)            |
| 15   | 2  | 3.5  | Fronteras entre países (countries' borders)          |
| 16   | 2  | 3.5  | Lagos (lakes)  |

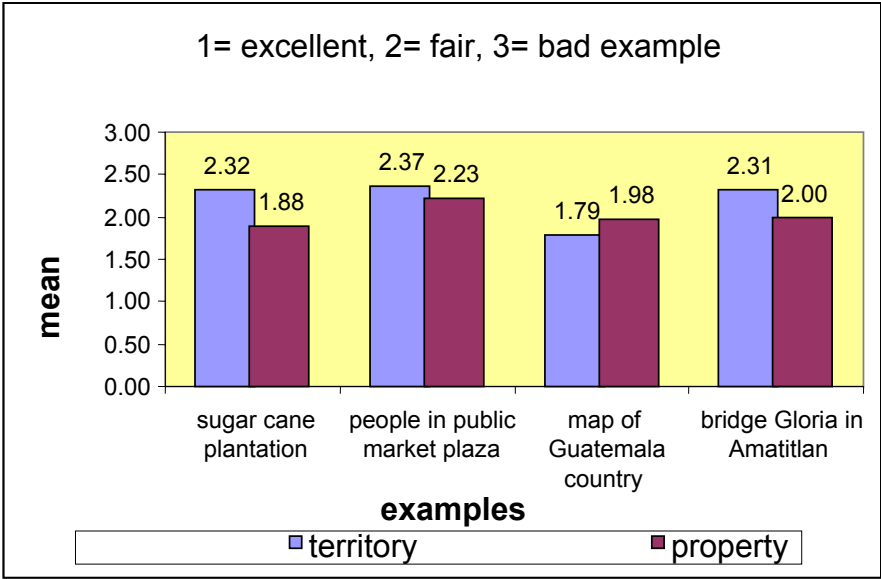
In addition, the question about the country map was complemented with an additional question: *What additional information would you like to find on a map?* Very few of the total subjects responded to that question, and those who did answer responded that they would like to find information about population, and about highways, languages, climate, geography, tourist sites and temperatures. This shows not only the preference of public users about information, but also that some of them did not understand the symbol of roads included in the conventional map because they mention highways as additional information. They also wanted information about “population,” “language,” “climate,” “geography,” “tourist sites,” and “temperatures.”



Nota: Los limites municipales no son autoritativos

### Map .2 Guatemala Country

From Guatemalan Geographic Institute webpage ( <http://www.ign.gov.gt/republic.htm> )

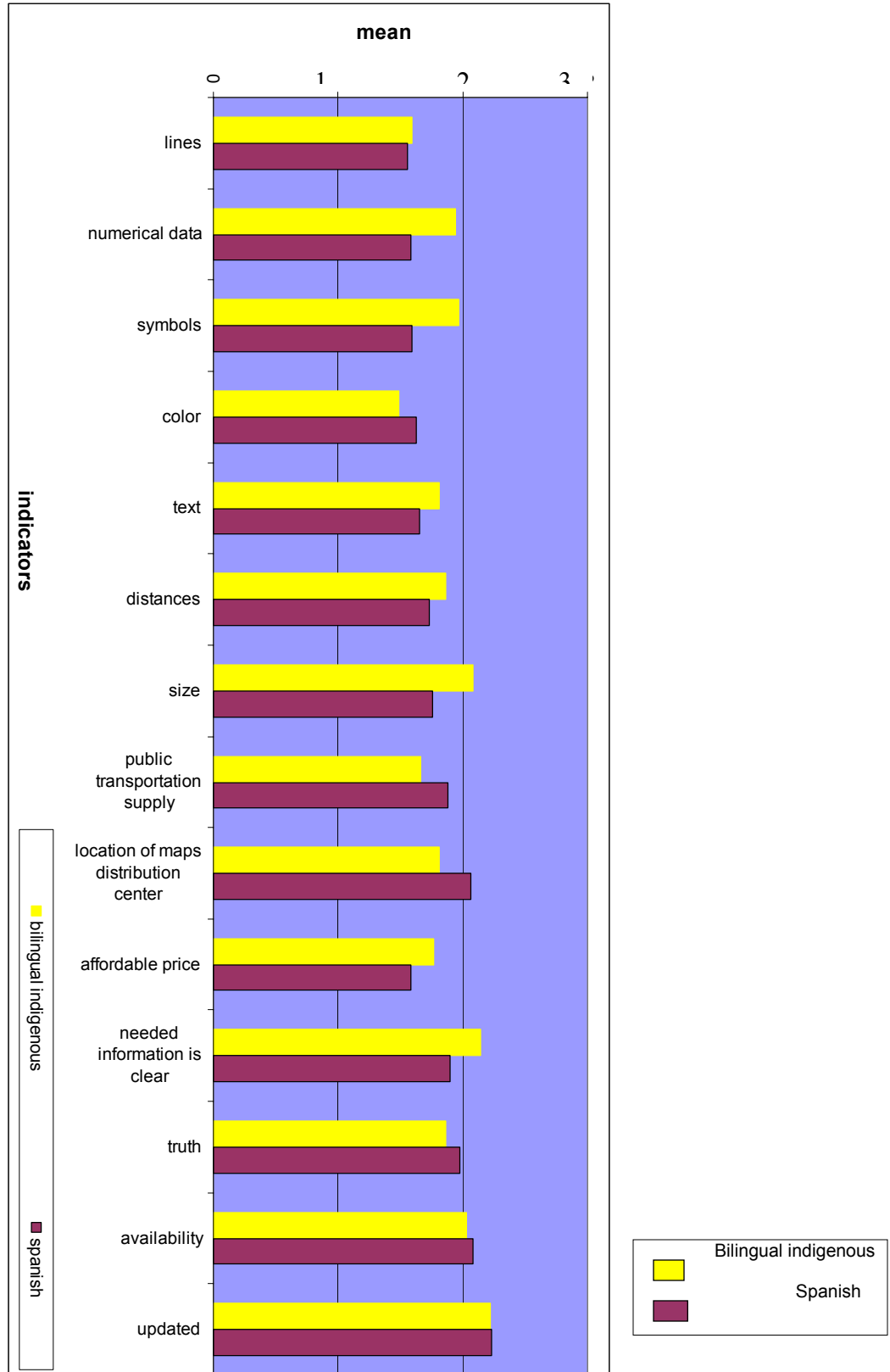


**Chart 1 Representation of Property and Territory  
Non Indigenous sample**

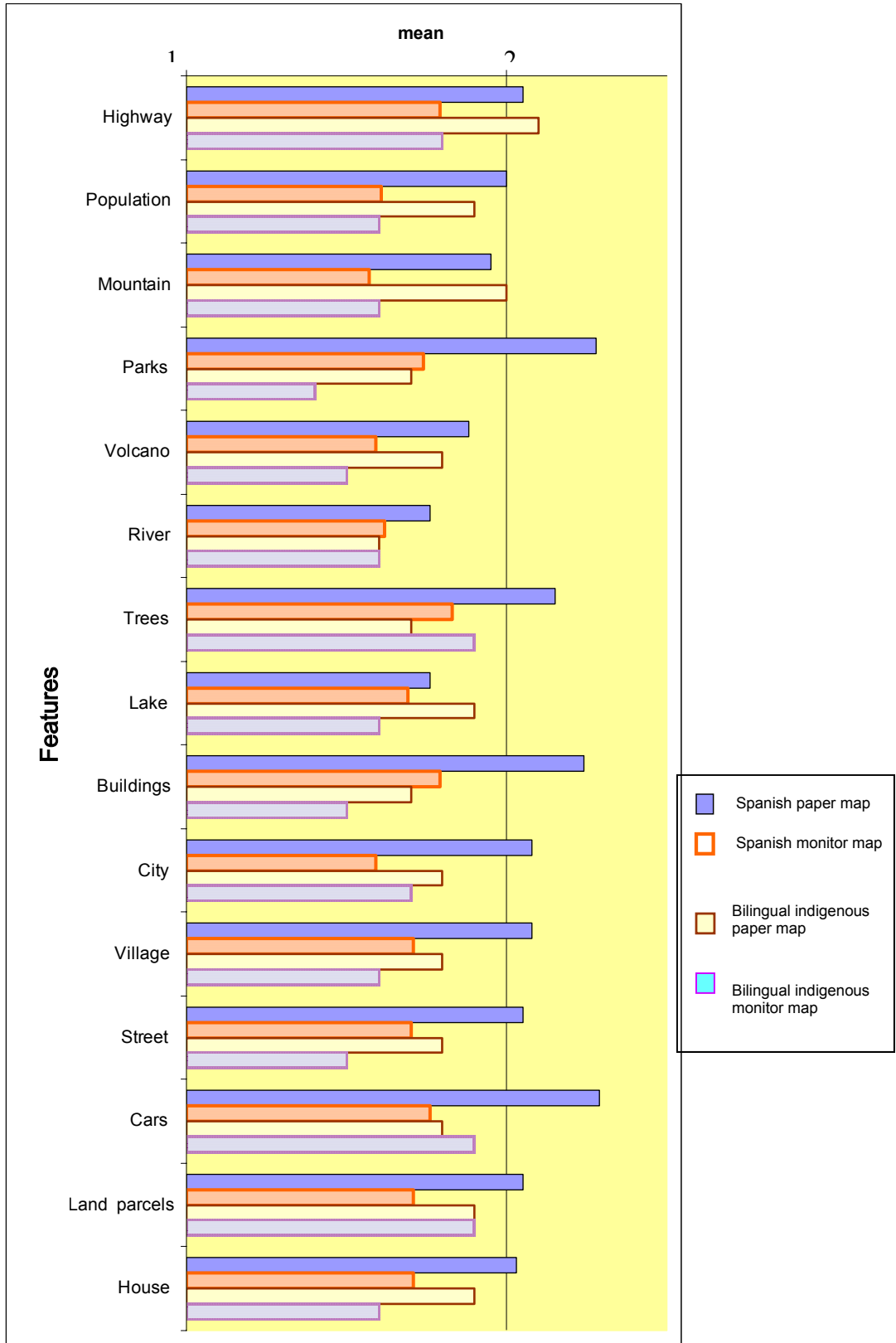


**Chart 2 Representation of Property and Territory  
Bilingual Indigenous sample**

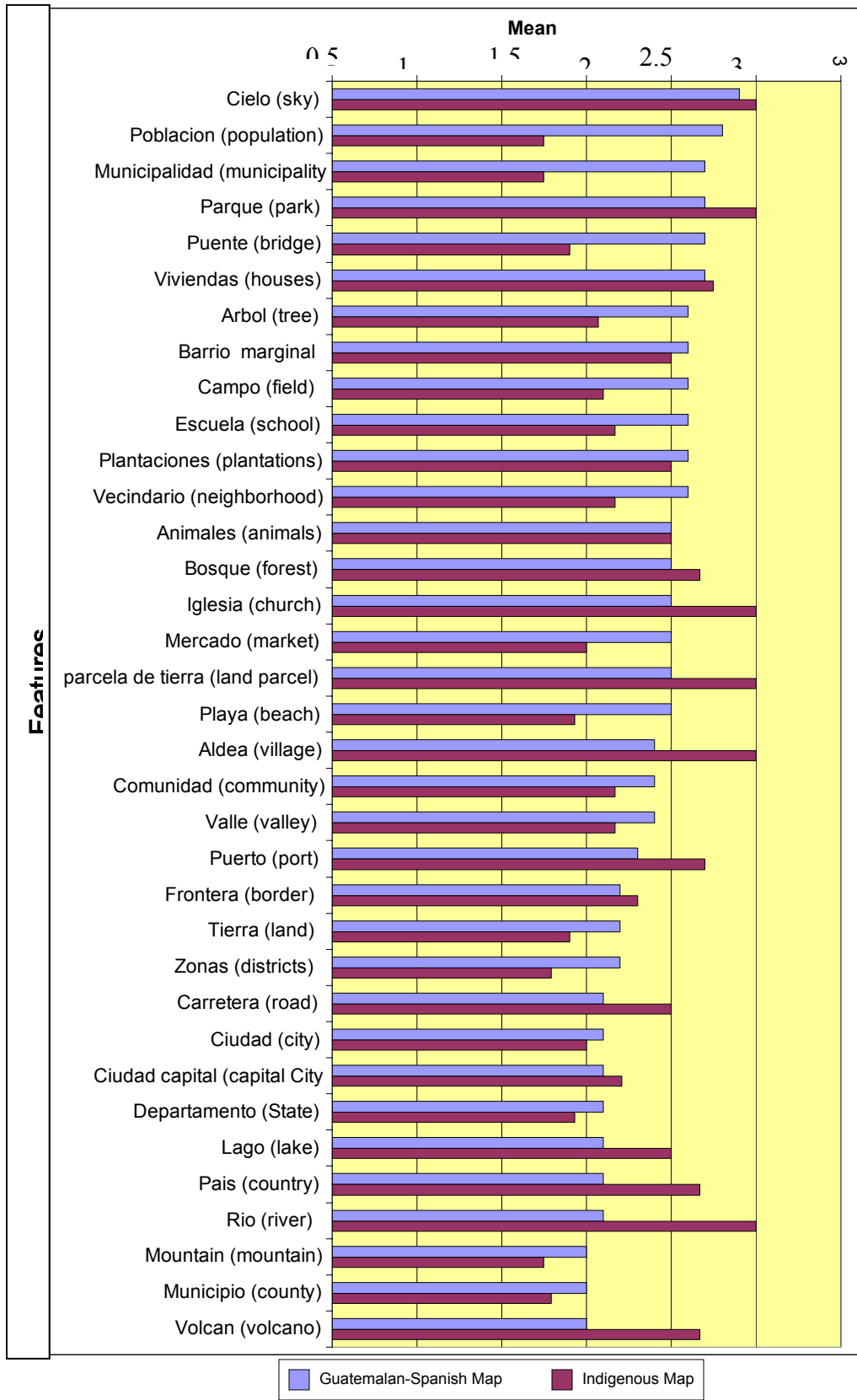




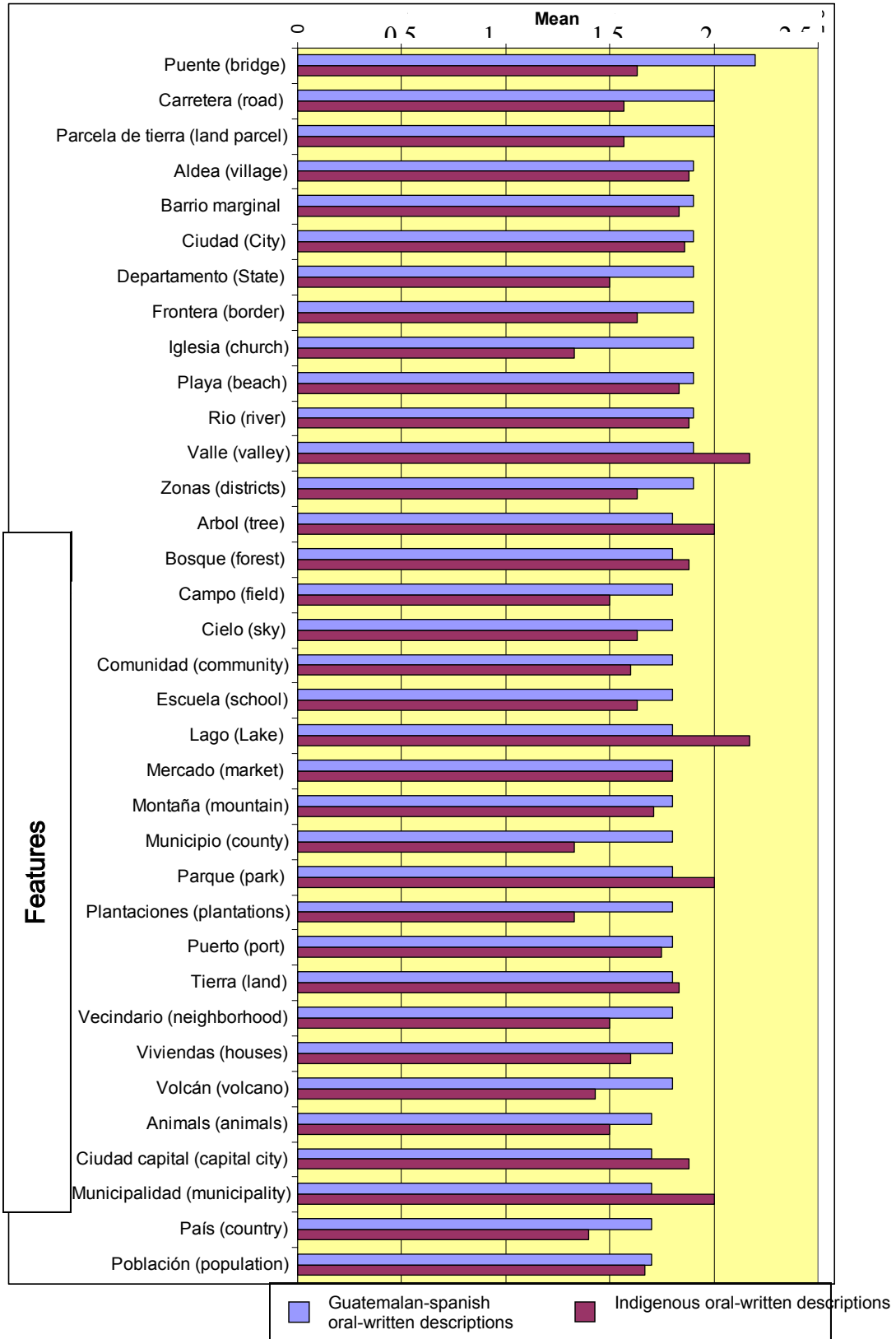
**Chart 3**  
**Map Performance between Spanish and Bilingual-Indigenous Samples**



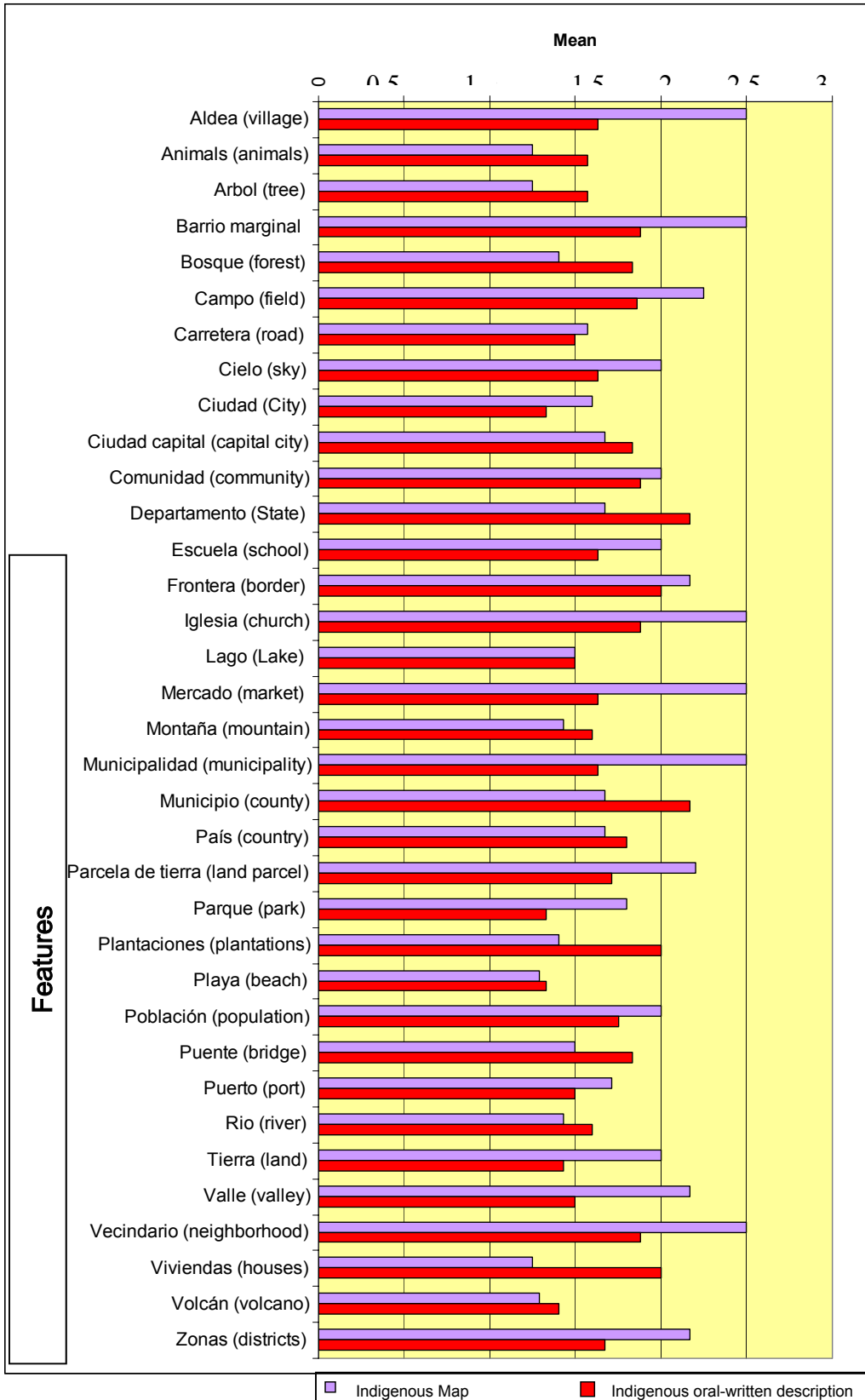
**Chart 4**  
**Comparing Learning and Comprehension of Paper-map versus Monitor-map**



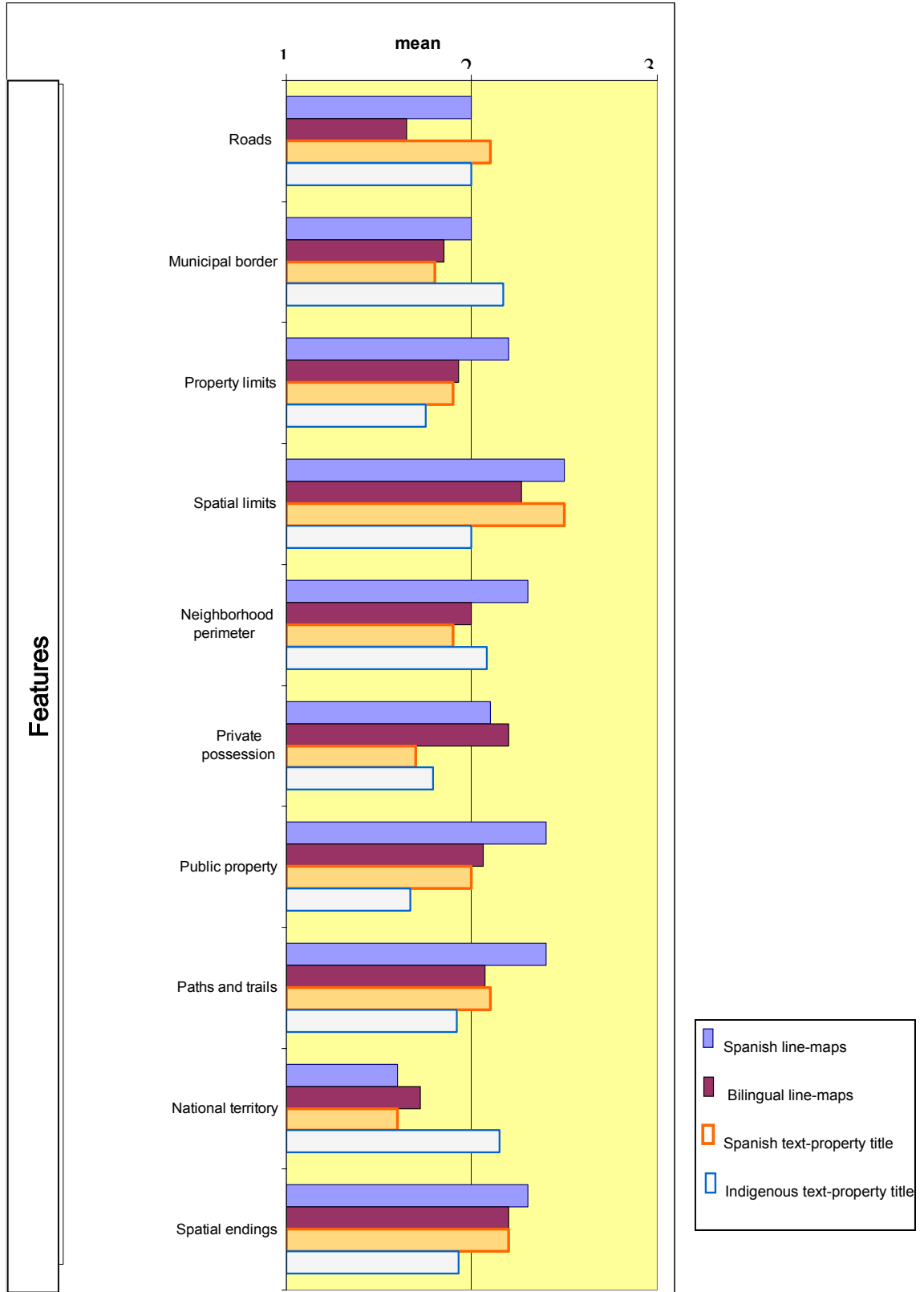
**Chart 5 Maps Clarity According to Guatemalan-Spanish and Indigenous Samples**



**Chart 6 Oral-Written Descriptions for Spanish and Indigenous Samples**



**Chart 7 Features in Maps and Oral-Written Descriptions for Indigenous Sample**



**Chart 8 Line-Maps versus Text-property Title for Spanish and Indigenous sample**

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