Spatial analysis to identify disparities in Philippine public school facilities

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This paper addresses the issues that affect school building conditions as a case study of the Philippines. Geographic information systems were utilized to investigate the allocation of public school resources and the extent of disparity in education facilities among 75 Philippine provinces. Four clusters of the provinces were identified by applying spatial statistics and regionalization techniques to the public school data. Overall, the building conditions are of high quality in the northern provinces. The greater region of the capital is overcrowded but well maintained. The eastern seaboard region and the southern provinces have poor conditions due to frequent natural calamities and the prolonged civil unrest, respectively. Since the spatial analysis result shows that the school building requirements are largely unmet, some recommendations are proposed so that they can be implemented by the government in order to improve the school facilities and mitigate the existing disparities among the four clusters of the Philippines.

Keywords: geographic information system; spatial analysis; cluster analysis; education disparity; local spatial statistics; regionalization

Introduction

The Philippines implemented a nationwide reform in its education system in June 2012. The main change was an increase of the pre-university education cycle from 10 to 12 years. This transformation demanded a significant investment in the education system’s human resources and facilities, which prompted the legislators to increase the education budget in 2014 to 4.3% of the country’s gross domestic product.\textsuperscript{1} It is well known that basic school facilities in the country have been inadequate and insufficient, with various media reports describing the dire situation at the start of every school year (Miralao, 2004). To alleviate the situation, various Philippine-based non-government organizations (NGOs), such as Synergeia and Check My School, have been working on developing local leadership, instilling public transparency and accountability, and engaging with local communities to monitor and support their local schools (Robredo, 2008; Shkabatur, 2012). This insufficiency is a perennial national problem but is understudied due to the scarcity of publicly available data on education facilities. Only a few researchers have investigated the Philippine public school facilities, including Alba (2010a) who utilized government-provided data to demonstrate congestion as well as

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underutilization of teachers, rooms and seats in high schools across regions through computer programming models, and Lanzona (2012) who recounted the incidence of poor quality and geographically unsafe classrooms in the country and claimed that poor politics of school principals is a key factor in these inadequate structures.

In the theoretical model of physical facilities and student outcomes, Cash (1993) formalized that financial allocations for education, school leadership and personnel maintenance impact the quality of school buildings in Philadelphia, Pennsylvania, USA. In addition, Tan, Lane, and Coustere (1997) demonstrated that community characteristics also affect school environments in their econometric model of student achievement in the Philippines. Aside from extending the work of Alba (2010a) and Lanzona (2012), the present study is also intended to enhance the model of Cash (1993) and explore the model of Tan et al. (1997) by identifying additional elements that affect school building conditions.

A survey of literature on the Philippine education facilities shows that a review of allocation policies and continued monitoring of resources has been often advised but was not conducted by the Philippines’ Department of Education (DepEd) (Alba, 2010b; Human Development Network, 2000; Maligalig, Caoli-Rodriguez, Martinez, et al., 2010; Miralao, 2004; Tan et al., 1997). Philippine public education was designed to be decentralized and financed by local governments when it was institutionalized during the American occupation (1898–1946). However, it was later centralized due to the lack of local financial resources. The Monroe Survey in 1925 disapproved of the excessive centralized control of public education in the country as it led to less involvement from other sectors. Eventually, the decentralization was restored in 2001 through the principal-led School Building Program (Bautista, Bernardo, & Ocampo, 2008). In this decentralized system, DepEd was responsible for the management of nearly 60,000 schools across the country (Table 1). Then the responsibility of financing and acquiring school sites in their territories were delegated to the municipalities and cities. Each school district has a local school board composed of teachers and parents who decide on matters relating to school funds and facilities.

Several studies confirmed that good school facilities improve the student experience, especially in the developing countries (Bacolod & Tobias, 2006; Behrman, 1994; Ghuman, Behrman, & Gultiano, 2006; Glewwe & Jacoby, 1994; Hanushek, 1995; Tan et al., 1997). A review of the published school facility literature from 1995 to 2010 found that fully equipped schools with well-maintained rooms, suitable classroom furniture and a school library produced better education outcomes (Glewwe, Hanushek, Humpage, et al., 2011). In the context of developing countries such as the Philippines, Nebres (2009) demonstrated how activities addressing macro-problems (e.g. social, political, and economic environments and physical facilities of the schools) had a more immediate and prominent impact on education outcomes than initiatives targeting the micro-problems (e.g. curriculum, teacher training, textbooks, etc.).

School facilities have to be monitored not only to ensure compliance with the recommended standards but also to minimize disparities across the country and provide its

| AY 2012–13 | Elementary | Secondary | Total |
|------------|------------|-----------|-------|
| Public     | 38,659     | 7748      | 46,407|
| Private    | 7745       | 5130      | 12,875|
| Total      | 46,404     | 12,878    | 59,282|
citizens equal access to education. To measure the quality and effectiveness of school facilities, some studies utilized specific variables such as building age, building cost accrued over time, classroom temperature, noise, lighting, ventilation, school furniture, space, attractiveness, and maintenance (Arsen & Davis, 2006; Cash, 1993; Earthman, Cash, & Van Berkum, 1995; Hines, 1996; Marshall, 2009; Maxwell & Schechtman, 2012; Uline & Tschannen-Moran, 2008). However, some studies employed an aggregated ‘score’ that accounted for more detailed building features which are used to evaluate school facilities (Buckley, Schneider, & Shang, 2004; Picus, Marion, Calvo, et al., 2005). For further discussion on school facility evaluation, see Beynon, Hallak, and Postlethwaite (1997), Hawkins and Lilley (1998), and Ortiz (2002). These studies demonstrated the various physical, environmental and financial conditions that have to be assessed and monitored in the evaluation of facility suitability.

The main aim of this study is to address the issues that affect school building conditions as a case study of the Philippines because only a few studies have been conducted and therefore the understanding of the Philippines’ education environment is very limited. School building conditions refer to the overall state of the school building facilities: its structural state as well as its capacity compared with the student population that it serves. The authors investigated the government-provided school facility data that represents 75.8% of the Philippine public schools to extend the findings of Alba (2010a) and Lanzona (2012). By utilizing various geographic information systems (GIS) analysis tools on provincial level data, this research attempts to portray the state of education facilities in geographical form and identify provincial patterns.

Geography is an essential factor in the establishment and supervision of nearly 60,000 schools across over 7000 islands in the Philippines, which has been described by Wernstedt and Spencer (1967) to possess numerous, varied and uncommon characteristics. This diverse geography has significantly contributed to the regionalism within the country, which is divided into three island groups: Luzon (the location of Manila, the capital), Visayas and Mindanao (Figure 1). There is a lack of regional convergence in the nation due to the concentration of economic activities in the capital (Diokno, 2012). Industrial development is rapidly progressing in the provinces situated in the northern island of Luzon, and is very slow among the provinces in the southern island of Mindanao. Poor transportation networks exacerbated further the alienation of those areas that are distant from the urban centres (Human Development Network, 2013).

The diverse geography of the country explains as much as 47% of the variation in provincial income poverty as well as a significant portion of the variance in health, education and income variations (Human Development Network, 2013). This interplay between economic activities and education outcomes in some developing countries is also discussed by Hanushek and Woessmann (2007). The Education Policy Data Center (2012) reported moderate regional disparities in primary school attendance rates in the country with the highest at 93% in the Ilocos Region (situated in the northern part of the country) and the lowest at 72% in the Autonomous Region of Muslim Mindanao (located in the southern part of the country). Similarly, the Human Development Network (2013) reported that years of schooling in the northern regions has higher values (i.e., better outcomes) than in the centre or southern regions. Moreover, they have demonstrated spatial autocorrelation in the years of schooling through global statistics such as Moran’s I. Spatial autocorrelation is the correlation in values of variables due to the proximity of their location, which is contrary to the assumption of independent observations in classical statistics (Griffith, 1987).
Various studies have utilized spatial analysis methods to investigate how school facilities affect education outcomes. Cunha, Jimenez, Perez, et al. (2009) applied global statistics, local statistics and a linear regression model to demonstrate that proximity to poor neighbourhoods result in lower education outcomes for students in the city of Campinas, Brazil. Chamarbagwala (2009) also employed global and local statistics but added spatial lag and error models to prove that school attendance in India is affected by spatially correlated cultural norms. Elias and Rey (2011) employed the same methods as Chamarbagwala (2009) but added a spatial cross-regressive model to show clusters of high-performing schools near the coast of Peru and low-performing schools near the rainforest and highlands. Another approach for spatial analysis was developed by Fotheringham, Charlton, and Brunsdon (2001) as they employed global and local regression models to estimate the spatial variation of mathematics scores in 3687 Northern England primary schools. This technique was replicated by Naidoo, van Eeden, and Münch (2013) as they employed global statistics, local statistics, global regression models and local regression models to prove clustering of education outcomes due to selected socio-economic factors within 261 secondary schools in Cape Town, South Africa.

Similar to the previous papers, this study will employ global statistics to establish spatial autocorrelation as well as local statistics to analyse the clusters. However, since the authors’ goal is to identify spatial clustering in the data, the regression models that
were employed as a method to predict variable relationships are not appropriate. Moreover, the techniques utilized in the previous studies only permitted the analysis and visualization of cluster characteristics one variable at a time. Instead, this study employs regionalization methods that use minimum spanning trees (Assuncao et al., 2006) in addition to global and local statistics in order to be able to analyse the characteristics of the clusters. This method enables the analysis of multiple variables simultaneously while adjusting for their geographic location and proximity to each other. In doing so, this paper presents essential evidence on the effect of geography on education facilities and demonstrates that regionalization methods are useful to analyse various indicators simultaneously and characterize spatial clusters that are difficult to be recognized through global and local statistics alone.

The main objective of this study is to determine the extent of provincial disparities in the provision of school facilities and investigate where and how education resources can be allocated in order to alleviate the disparities. This study attempts to identify other factors that affect school facilities and demonstrate how regionalization methods are able to analyse various indicators simultaneously and characterize spatial clusters. GIS spatial analysis methods are utilized in order to demonstrate how school facilities are also affected by geography and the socio-economic conditions of neighbouring provinces. The paper begins with the presentation of the indicators for measuring school facilities and is followed by presentation of the GIS methods and results. It concludes with a discussion of the implications for government policies and school facilities in various regions of the country.

Data

Study area

The study area is the whole Philippines except for one region where the school facility data are not available: the Autonomous Region of Muslim Mindanao, which is composed of five provinces. The Philippines is an archipelagic state of 7107 islands with a land area of 300,000 km². It is jurisdictionally divided into 17 regions, 81 provinces, 144 cities and 1490 municipalities (Figure 1). It has one of the highest population growth rates at 1.9% annually and has officially reached the 100 million mark last July 2014 (Clarisse & Obanil, 2014). Philippine maps with jurisdictional boundaries (municipal, provincial, regional) were downloaded from PhilGIS.org, a website that provides free Philippine geographic data for educational and non-profit use.

School facility data

The public school facility data were acquired by the School Mapping Unit of the Philippines’ DepEd through a survey form that was distributed to all public schools and filled out by the school administrators. Closer inspection of the data reveals that 39 provinces had a good response rate that was greater than 90%, 28 provinces had a response rate between 60% and 90%, and eight provinces had a poor response rate that was below 60% (Table 2). The most complete table has school facility data up to 75.8% of all schools. It is still a good survey response rate because it represents approximately 30,000 out of 45,000 schools across 75 out of 81 provinces in the country.

Despite the availability of school-level data, the aggregated provincial level-data were utilized for several reasons: firstly, for the purpose of comparability of the results with other papers since all nationwide-level studies conducted in the country reported
provincial level results; secondly, to prepare the data for further analysis and merge it with examination scores that are also aggregated to provincial levels; and thirdly, school-level analysis yielded inconclusive results and were not meaningful enough for cluster analysis.

School condition indicators

Many of the variables considered in the evaluation of school facilities cited in the Introduction section are available in the GIS-based School Profiling Database. However, provincial representation is low in the database. Hence, only the variables with almost complete records (i.e. the variables responded by almost all schools) are utilized. The building condition values can be used to measure the quality of the school facilities while the ratios of students to classrooms, toilets and seats can be used to estimate the size of the school facilities in comparison with the student population that it serves (Table 3). Intuitively, low student–classroom ratios, low student–toilet ratios, and low student–seat ratios are expected for the students’ well-being. In addition to such school condition indicators, lower building condition scores are desirable as they indicate better buildings. Hence, the study includes all of the above indicators.

One of the limitations in this study is the lack of data regarding ‘double shifts’ for the student population. It is a common strategy for overcrowded schools to implement double shifts as this allows them to maintain the recommended ratios of students to facilities. In fact the school division office in Quezon City (the country’s largest city in terms of population) assumes double shifts in their formula to determine a school’s required number of classrooms. Double shifts reduce overcrowding and maximizes the use of school facilities as the school divides the students into groups and accommodates one group at a time for each school day (Bray, 2000). In urban areas of the Philippines, one group of pupils attend school in the morning and a second group in the afternoon. Although each school reports population about double shifts annually, the data are unfortunately not available for this study.

Table 3. School representation for each indicator.

| Building quality               | Building condition       | 34,253 | 75.8 |
| Building size                 | Pupil-to-classroom ratio | 34,253 | 75.8 |
|                              | Pupil-to-seat ratio      | 29,302 | 64.8 |
|                              | Pupil-to-toilet ratio    | 28,830 | 63.8 |

The Dinagat Islands was merged with Surigao del Norte in the GIS-based School Profiling Survey.
Building condition

In the survey, the school administrator assessed each building in the school as: ‘good’, ‘needs repair’ and ‘dilapidated’. The data reveal that only 38% of the school buildings are in good condition. For analysis, a numeric value is assigned to each building condition ($BC$), where lower $BC$ values indicate better school buildings:

$$BC = \begin{cases} 
1, & \text{good} \\
2, & \text{needs repair} \\
3, & \text{dilapidated}
\end{cases}$$

A public school usually has four buildings in the Philippines. The mean value is obtained in order to calculate one $BC_i$ per school $i$. A province $p$’s building condition score $BC_p$ is calculated as the mean $BC_i$ among all schools within province $p$. A score of 1.5 (midpoint between ‘good’ and ‘needs repair’) is proposed as acceptable for schools.

Pupil-to-toilet ratio

The number of toilets and urinals per school building is shown in the GIS-based School Profiling Database. The toilet users are teachers and students. For this study, only toilets being used by students are considered. The toilets are further classified as for male, female or shared use.

The data indicate that 81% of the public school toilets are unisex facilities, except for the country’s capital where 90% are separate toilets. With overall student enrolment data at hand, we combine all male, female and unisex toilets to compute a pupil-to-toilet ratio ($PTR$) per school:

$$PTR_i = \frac{e_i}{(m_i + f_i + u_i)}$$

where, for each school $i$, $PTR_i$ is the pupil-to-toilet ratio; $e_i$ is the overall student enrolment; $m_i$ is the total number of male toilets; $f_i$ is the total number of female toilets; and $u_i$ is the total number of unisex toilets.

Due to large variations in the toilet data, the median (instead of the mean) pupil-to-toilet ratio $PTR_i$ among all schools within province $p$ is utilized to calculate a $PTR_p$ for each province.

In the provision of sanitary facilities, the Philippines’ DepEd (2010) requires one toilet seat for every 50 females and one toilet seat for every 100 males. This standard varies for each country but the international standard is 25:1 for females and 30:1 for males (see Table 4 for a comparison). In the absence of recommendations regarding unisex toilets that are prevalent in the Philippines, we propose a recommended pupil-to-toilet ratio ($tu$) for the country:

$$tu(x) = t_m(x) + t_f(x)$$

where $tu$ is the recommended number of unisex toilet provisions for $x$ pupils; $t_m$ is the recommended number of male toilet provisions for $x$ pupils; and $t_f$ is the recommended number of female toilet provisions for $x$ pupils. After substituting the number of recommended toilets for the Philippines, equation (3) results in $tu = 3$ for $x = 100$, which is approximately 33 pupils for each unisex toilet. Individual inspection of each province reveals that only seven of 75 provinces satisfy the proposed $tu$ in the Philippines (Figure 2).
The formula to compute the pupil-to-classroom ratio ($PCR_i$) is:

$$PCR_i = \frac{e_i}{c_i} \tag{4}$$

where, for each school $i$, $PCR_i$ is the pupil-to-classroom ratio; $e_i$ is the overall student enrolment; and $c_i$ is the total number of classrooms. A province $p$’s $PCR_p$ is calculated as the mean $PCR_i$ among all schools within province $p$.

Ideally, classroom area should be used in the computation of the $PCR_i$. However, we use the total number of classrooms instead because of unavailability of classroom area data. Whether a classroom can accommodate 30 or 60 students, it is still evaluated against the DepEd’s recommended $PCR$ of 45. Individual inspection of $PCR_p$ reveals that 50 out of 75 provinces satisfy the recommended $PCR$ (Figure 2). If double shifts in the severely overcrowded areas are considered, $PCR_p$ will be generally acceptable for all the provinces. Figure 2 shows that only one province (Batangas) has the right balance of classroom and toilet facilities to its student population. The other provinces had

![Figure 2](image_url)
either too many or too few students for its current facilities. Hence, similar to a study by Alba (2010a) on public school congestion in 2007, the GIS-based School Profiling Database also reveals congestion in most provinces and underutilization of resources in a few provinces.

Pupil-to-seat ratio

There are three types of classroom furniture in the GIS-based School Profiling Database: table and chair sets, armchairs, and desks. This study assumes that only one student sits in an armchair and two students are assigned to a desk. It is also assumed that two students sit at a table and chair set, but in reality three or four students would be squeezed in depending on class size. The pupil-to-seat ratio (PSR) is calculated using:

$$PSR_i = \frac{e_i}{a_i + 2(t_i + d_i)}$$

(5)

where, for each school $i$, $PSR_i$ is the pupil-to-seat ratio; $e_i$ is the overall student enrolment; $a_i$ is the total number of armchairs; $t_i$ is the total number of table and chair sets; and $d_i$ is the total number of desks.

Due to large variations in the classroom furniture data, the median $PSR_i$ among all schools within province $p$ is used to calculate the $PSR_p$.

Results

Global and local statistics

A distance that reflects the intensity of clustering in the school facility variables was selected by examining the distances between provinces and computing for Moran’s $I$ at increasing distances. Since the $z$-scores of Moran’s $I$ reveals the intensity of clustering, we select the distances with significant peaks in the $z$-scores. Figure 3 indicates that clusters are best observed at the distance of 225 km for building conditions and pupil-to-classroom ratios, while 250 km is best for pupil-to-seat ratios. Clusters in pupil-to-toilet ratios were best observed at a distance of 375 km. The westernmost province of Palawan had no neighbours within 375 km, while the northernmost province of Batanes had no neighbours within 250 km. This is acceptable since the two remote provinces may be more related to the capital than the nearest provinces due to direct transportation routes which may be a better means of representing the adjacency between provinces but were unfortunately not available for analysis.

Table 5 shows the results of computing Moran’s $I$ and indicates that the quality and the size of the school facilities (as expressed in $BC_p$, $PCR_p$, $PSR_p$ and $PTR_p$) signify a statistically significant clustered pattern and strongly influence neighbouring provinces in the entire dataset. Although the Moran’s $I$ for the $PTR_p$ is not as strong as the other variables.

Statistically significant spatial clusters were identified by using the optimal distances in Table 5. FDR correction was employed to account for multiple testing and overlapping subsamples. The hotspots in Figure 4 and the clusters in Figure 5 indicate that northern provinces have the best $PCR_p$ and $PSR_p$, while the southern provinces had the worst $PCR_p$ and $PSR_p$. The country’s capital and its surrounding provinces had the best $BC_p$ but were the most overcrowded with the worst $PCR_p$. One province adjacent to the country’s capital (i.e., Rizal) had the worst $PTR_p$ as indicated in Figure 5(d), while another province (i.e., Batangas) was identified as a high–low outlier with poor
buildings surrounded by provinces with relatively good buildings in Figure 5(a). The eastern provinces had the worst $BC_p$ and $PSR_p$ with one province (i.e., Marinduque) identified as a low–high outlier with good $PCRp$ while surrounded by provinces with overcrowded classrooms.

Regionalization

Without spatial constraints

To determine the effect of geography, the data were first examined based on school facility data alone and without any consideration for location. The $k$-means algorithm calculated that the data should be partitioned in two groups to minimize the differences among the features in a group. It classified 53 provinces into Group X (blue) while the remaining 22 provinces into Group Y (red), as illustrated in Figure 6. Although geographic location is not considered, the map indicates that the provinces in each group are still predominantly close to each other. The grouping analysis tool of ArcMap as shown in Figure 6 generates a map and parallel box plot of the results. Table 6 shows that Group X is a group of the provinces with better facilities as its mean $PTR_p$, $PSR_p$, $PCRp$ and $BC_p$ values were closer to the recommended standard ratios. On the other hand, Group Y is a group of the provinces with poor facilities. Its $PSR_p$ and $BC_p$ values

![Spatial Autocorrelation by Distance](image)

Figure 3. Computed z-scores of Moran’s $I$ for each school facility variable at increasing distances between provinces (building conditions ($BC_p$), pupil-to-classroom ratios ($PCRp$), pupil-to-seat ratios ($PSR_p$) and pupil-to-toilet ratios ($PTR_p$)).

Table 5. Moran’s $I$ for each indicator.

| Variable | Distance (km) | Moran’s $I$ | Variance | $z$-score$^a$ | $p$-value |
|----------|---------------|-------------|----------|---------------|-----------|
| $PCRp$   | 225           | 0.33        | 0.0019   | 7.8           | 0.00      |
| $BC_p$   | 225           | 0.24        | 0.0020   | 5.7           | 0.00      |
| $PSR_p$  | 250           | 0.18        | 0.0017   | 4.6           | 0.00      |
| $PTR_p$  | 375           | 0.07        | 0.0009   | 3.0           | 0.00      |

$^a$The expected value for Moran’s $I$ statistic is $E(I) = -\frac{1}{n-1} = -0.013(n = 75)$. 
are inferior (i.e., higher) and its $PTR_p$ and $PCR_p$ values are almost twice that of Group X. Table 6 also indicates that $PTR_p$ is a more effective predictor of clustering (i.e., highest $R^2$) when the provinces are grouped in two clusters without considering location while $BC_p$ varies little throughout the country and are the least likely to predict clustering (i.e., lowest $R^2$).

Utilizing a spatial weights matrix

Examining the spatial relationships between provinces through contiguity is not appropriate due to the archipelagic geography of the Philippines. Some provinces are adjacent to each other while some are separated by the sea. Transportation networks can provide a more accurate representation of the spatial relationships between the provinces but it was not available for analysis. A spatial weighting matrix that designates provinces within a threshold distance as related to each other was utilized. Figure 3 indicates that clusters are best observed starting at the distance of 200 km. The Calinski and Harabasz (1974) pseudo-$F$-statistic indicates that the data are best grouped in five clusters. The SKATER algorithm classifies two provinces closest to the country’s capital as Group A (blue), 18 northern provinces as Group B (red), seven provinces in the country’s eastern seaboard as Group C (green), six southern provinces as Group D (yellow), and the remaining 42
provinces generally located throughout the country as Group E (purple). The location of the groups are shown in Figure 7.

Comparison of the results shows that Group X represents an aggregation of Groups A, C, D and some of E, while Group Y represents Group B and some of Group E. The corresponding parallel box plot in Figure 7 shows that Group A has the best facilities in terms of quality as it has the best $BC_p$, but is severely overcrowded with the worst $PTR_p$.

**Table 6.** Group-wise summary of regionalization without spatial constraints.

| Group | Mean | SD  | Minimum | Maximum | Share (%) |
|-------|------|-----|---------|---------|-----------|
| $PTR_p$ $R^2 = 0.49$ | | | | | |
| Group X | 45.4 | 8.9 | 26.5 | 65 | 25 |
| Group Y | 81.2 | 27.1 | 43.0 | 176 | 88 |
| All | 55.9 | 23.1 | 26.5 | 176 | 100 |
| $PSR_p$ $R^2 = 0.41$ | | | | | |
| Group X | 1.02 | 0.14 | 0.64 | 1.25 | 58 |
| Group Y | 1.30 | 0.18 | 0.97 | 1.69 | 68 |
| All | 1.1 | 0.20 | 0.64 | 1.69 | 100 |
| $PCR_p$ $R^2 = 0.34$ | | | | | |
| Group X | 35.9 | 9.7 | 9.6 | 57.8 | 59 |
| Group Y | 52.2 | 11.8 | 34.5 | 90.8 | 69 |
| All | 40.7 | 12.8 | 9.6 | 90.8 | 100 |
| $BC_p$ $R^2 = 0.09$ | | | | | |
| Group X | 1.66 | 0.08 | 1.45 | 1.81 | 85 |
| Group Y | 1.72 | 0.10 | 1.46 | 1.88 | 97 |
| All | 1.67 | 0.09 | 1.45 | 1.88 | 100 |

Note: $R^2$ denotes the effectiveness of the variable in classifying the provinces into groups.

Figure 6. Map and parallel box plot for grouping analysis without spatial constraints.
and $PCR_p$. However, if double shifts in the schools are considered and the Group A values are divided in half, it would have the same $PTR_p$ as Groups C and D, a comparable $PCR_p$ as Group E, and possibly have too many seats. This supports the findings of Alba (2010a) where the country’s capital (included in Group A) had the largest number of empty seats during school year 2007–08. Group B has the best facilities that are good in quality as well as in size with its average $BC_p$, $PSR_p$ and $PCR_p$. It also has the best $PTR_p$. Groups C and D generally have the worst $BC_p$ and critically high $PTR_p$. Group E spans across the whole country and portrays the ‘average’ school facility in the Philippines. Disparity between groups of provinces is clearly observed where, for all variables, the worst-case scenario for the best group (Group B) is generally the best-case scenario for the poorest groups (Groups C and D).

Table 7 shows that $PTR_p$ is a more effective predictor of clustering (i.e., highest $R^2$) when the data are grouped in five clusters using a 200-km spatial weight matrix (Figure 7) while $BC_p$ varies little throughout the country and are the least likely to predict clustering (i.e., lowest $R^2$).

Resources required to minimize disparity

Based on the mean values in Table 7, almost all provinces are unable to meet the recommended standards for school facilities. The disparity will be reduced if each group aims to achieve these standards. But the groups can only attain the recommended standards in relation to the resources that they already have. The authors assessed and simulated the increase or decrease in resources that are needed to minimize provincial disparity in two steps. First, it is assessed how the provinces can achieve the proposed standards in relation to their current resources. Second, a scenario where the province resources are adjusted to achieve the proposed standards in relation to their groupings as indicated in Figure 7 is simulated.
The extent of increase or decrease of education resources in relation to the current resources in each group is calculated using:

$$Req_{rg} = \frac{x_{rg} - S_r}{x_{rg}}$$

where $Req_{rg}$ is the required change in the resource $r$ for the group $g$; $x_{rg}$ is the mean value of the resource $r$ for the group $g$; and $S_r$ is the recommended standard for the resource $r$ summarized as follows:

$$S_r = \begin{cases} 
33, & \text{PTR} \\
45, & \text{PCR} \\
1, & \text{PSR} \\
1.5, & \text{BC}
\end{cases}$$

The results presented in Table 8 indicate that there is an urgent need for an increase in sanitary facilities across all groups. School building conditions need to be improved for all except Group A, as the quality of their buildings is still acceptable even if 7%
become dilapidated (currently evaluated as good but later becomes in need of repair). The classrooms and seats of Group E is sufficient while those of Groups A and B can be reallocated and those of Groups C and D should be increased.

Suppose that the values in Table 8 (i.e., \( Req_{r,g} \)) are satisfied, then the adjusted resource value for each province can be calculated using:

\[
AdjReq_{r,p,g} = y_{r,p} \times \frac{S_r}{x_{r,g}}
\]  

(8)

where \( AdjReq_{r,p,g} \) is the adjusted value in the resource \( r \) for the province \( p \) in the group \( g \); \( y_{r,p} \) is the mean value of the resource \( r \) for the province \( p \); \( x_{r,g} \) is the mean value of the resource \( r \) for the group \( g \); and \( S_r \) is the recommended standard for the resource \( r \) that was summarized in equation (7).

In equation (8), a province is limited by its group as it attempts to attain the recommended standards. For example, Figure 6 indicates that the country’s capital belongs to Group A (blue). Equation (7) indicates that the recommended PTR standard (\( S_{PTR} \)) is 33. Table 7 indicates that the mean PTR in Group A (\( x_{PTR,Group A} \)) is 141.5. Substituting these values in equation (8) yields \( \frac{S_r}{x_{r,g}} = 0.23 \), which is the rate of increase (or decrease) in toilet resources that will be applied for all provinces \( p \) within Group A. Multiplying this rate with \( y_{r,p} \) means that province \( p \)’s resource \( r \) can only increase or decrease in proportion to the group rate. Hence, if province \( p \)’s resource \( r \) is equal to its group \( g \)’s resource \( r \), then it will meet the recommended standard for the resource \( r \) accurately. Individual province data (see the Appendix) indicates that the mean PTR in the capital

| Group g                                      | Increase in the number of unisex toilets | Increase in the number (or reallocation) of classrooms | Increase in the number (or reallocation) of seats | Buildings that should be improved\(^a\) |
|----------------------------------------------|------------------------------------------|-------------------------------------------------------|--------------------------------------------------|-----------------------------------------|
| Severely overcrowded but good quality facilities (capital and surrounding provinces) | 77%                                       | 40%                                                   | 29%                                               | −7%                                     |
| Group A (blue) (double shift)                |                                          |                                                       |                                                   |                                         |
| Good facilities (northern provinces)         | 21%                                       | −67%                                                  | −11%                                              | 6%                                      |
| Group B (red)                                |                                          |                                                       |                                                   |                                         |
| Poor facilities (eastern seaboard and southern provinces) | 59%                                       | 6%                                                    | 23%                                               | 17%                                     |
| Group C (green)                              | 27%                                       | 20%                                                   | 23%                                               | 12%                                     |
| Group D (yellow)                             | 34%                                       | −10%                                                  | 0%                                                | 6%                                      |
| Average facilities (most of the provinces in the country) | 40%                                       | −13%                                                  | 9%                                                | 6%                                      |
| Group E (purple)                             |                                          |                                                       |                                                   |                                         |
| Overall (across the whole country)           |                                          |                                                       |                                                   |                                         |

\(^a\)Positive values: number of buildings that should be in ‘GOOD’ condition from initially being evaluated as ‘NEEDS REPAIR’. Negative values: number of buildings that are acceptable to be in NEED of REPAIR from initially being evaluated as ‘GOOD’.
(YPTR-Capital) is 176, which is not equal to the mean PTR in Group A. Hence the capital will miss the target standard PTR in proportion to its distance from the mean PTR of Group A. Based on this example, Equation (8) yields \( \text{AdjReq}_{\text{toilets,Capital,Group A}} = 41 \). This means that based on the existing PTR in the country’s capital and in Group A, the capital will not reach the recommended standard PTR of 33 but will only achieve a PTR of 41.

Figure 8 displays the results as we reran cluster analysis and regionalization using the computed AdjReq values. The Calinski–Harabasz pseudo-F-statistic indicates that the simulated data are best grouped into just two clusters. The grouping analysis tool places nine provinces in Group F (blue). This group is perceived to have the best building conditions but the facilities are still somewhat overcrowded. The remaining 66 provinces are placed in Group G (red). Table 9 shows that this group has met the recommended standards for school facilities and represents the average school facilities in the country. The characteristics of both groups are shown in the corresponding parallel box plot in Figure 8. Overall variable statistics show that \( \text{PCR}_p \) has now become the more effective predictor of clustering (i.e., highest \( R^2 \)).

**Discussion**

Similar to the work by Alba (2010a), this study also found congestion and underutilization of facilities not only in public high schools but also in public elementary schools. We found that the ratio of classrooms, toilets and seats in clusters of the northern provinces are consistently in excess while the clusters of provinces around the highly populated capital, the eastern seaboard and the south are consistently deficient. The lack of public education facilities that serve the disproportionately large population in the capital cannot be solved even with a proposed reallocation of education resources in
proportion to the current resources. Hence, the current practice of double shifts cannot be eradicated.

This study also found a clear need for more toilet facilities in public schools across the country. Even the group of provinces with good facilities i.e. Group B is unable to satisfy the proposed standard for toilets \( t_u \) with its current mean \( PTR_p \) of 42. But more disturbing is the fact that the group of provinces with severely overcrowded facilities i.e. Group A has a mean \( PTR_p \) of 141 (if double shift is considered, it is still a distressing 70 students per toilet). The quantity of needed toilets will be reduced if separate male and female toilet facilities are built instead of unisex toilets. In the aim of maximizing the limited resources and satisfying government standards, DepEd should discourage unisex toilets because they are meant to accommodate fewer pupils than separate toilets. A literature review of sanitation in schools performed by Jasper, Le, and Bartram (2012) shows that better access to these facilities increase school attendance and promote children’s health, however, the effects on education outcomes have not been proven yet. In the case of the Philippines, it is worth noting that the students are not the only users of these facilities. There are reports from rural schools where the local community uses the school toilets during weekends.

Individual inspection of each province reveals that only 15 out of 75 provinces have a mean \( BC_p \) that is better than or equal to the proposed standard \( BC_p \) of 1.5. Among the five groups, only the severely overcrowded Group A located near the capital is able to meet this target. Although the building condition assessments utilized in the study may seem basic, Roberts (2009) showed its correlation with learning outcomes when school facilities are measured in terms of educational functions.

Similar to Lanzona (2012), this study also found poor quality buildings in geographically vulnerable areas. We found that in the country’s typhoon-prone eastern seaboard, school buildings are more dilapidated. Moreover, we also found that the deterioration of

| Group | Mean | SD | Minimum | Maximum | Share (%) |
|-------|------|----|---------|---------|-----------|
| \( PCRp \) \( R^2 = 0.21 \) | Group F | 56.4 | 3.8 | 50.6 | 63.4 | 23 |
| | Group G | 43.4 | 8.6 | 15.5 | 71.0 | 100 |
| | All | 45.0 | 9.2 | 15.5 | 71.0 | 100 |
| \( BCp \) \( R^2 = 0.13 \) | Group F | 1.43 | 0.07 | 1.31 | 1.53 | 69 |
| | Group G | 1.50 | 0.06 | 1.35 | 1.63 | 87 |
| | All | 1.50 | 0.06 | 1.31 | 1.63 | 100 |
| \( PSRp \) \( R^2 = 0.05 \) | Group F | 1.08 | 0.11 | 0.87 | 1.22 | 50 |
| | Group G | 0.98 | 0.13 | 0.61 | 1.31 | 100 |
| | All | 1.00 | 0.14 | 0.61 | 1.31 | 100 |
| \( PTRp \) \( R^2 = 0.01 \) | Group F | 35.4 | 2.9 | 32.0 | 41.0 | 23 |
| | Group G | 32.6 | 8.3 | 19.4 | 57.0 | 100 |
| | All | 33.0 | 7.9 | 19.4 | 57.0 | 100 |

Note: \( R^2 \) denotes the effectiveness of the variable in classifying the provinces into groups.
school buildings in provinces experiencing prolonged civil unrest is comparable to school buildings experiencing natural calamities.

The DepEd has fully documented how these community disruptions affect schools in a Disaster Risk Reduction Resource Manual that was disseminated with the aim of protecting the lives of the school community members and ensuring the safety of school sites during disasters (DepEd, 2008). However, Lanzona (2012) recounted how numerous conflicts affecting the bureaucracy resulted in unsafe buildings even when geography was considered. Moreover, the government is forced to build schools on unsuitable sites (i.e., near geographically unsafe areas) if there is sufficient population demand within the area.

Since the Philippine schools are converted to evacuation centres during times of disasters (whether the disruptions are caused by humans or the environment), the government should take into account the extent or rate of damage that are affecting facilities located in unsafe areas as opposed to facilities in other (safer) areas. The government agencies that manage activities related to these events should then provide the affected schools with more financial resources in order to build stronger buildings or conduct more frequent facility maintenance. After the disasters, affected buildings can either be repaired or renovated.

Tan et al. (1997) formalized the effect of community characteristics (which they were able to express as the region where the family resides) on class and school environments in their econometric model of student achievement by utilizing household and school survey data from the Philippines. Similarly, the effect of the natural and social environment on education outcomes has been demonstrated through spatial analysis in the related researches cited in the Introduction section. Based on the findings from the spatial analysis of school building conditions in the Philippines, we conclude that community characteristics, specifically the natural and social environments in the school’s provincial address, affect the condition of education facilities. We therefore propose to enhance the model of Cash (1993) and add the natural and social environments as a factor that affects the condition of education facilities aside from financial allocations and school leadership as indicated in Figure 9.

The present study illustrates that local statistics and regionalization using province-level data can reveal provincial clusters that non-spatial analysis models cannot. When the four indicators are analysed without considering location, the country is separated in just two clusters by the Calinski–Harabasz pseudo-$F$-statistic which, interestingly, are still predominantly close to each other as evaluated by the $k$-means algorithm: Group X with good and average facilities (clustered in the northern and southern provinces and other parts of the country), and Group Y with poor facilities (clustered in the capital, Building Condition

**Figure 9.** Proposed enhancement to the Cash (1993) model of the relationship between school physical environment and student outcome variables.
the eastern seaboard, the south, and other parts of the country). However, when the four variables are evaluated in relation to their geographic location, the application of the Calinski–Harabasz pseudo-$F$-statistic results in five clusters. Then, the SKATER algorithm determines these five groups of provinces that share similar characteristics. The five clusters represent the provinces with good facilities (northern provinces), the provinces with severely overcrowded but good quality facilities (the capital and adjacent provinces), the provinces with average facilities (most of the provinces in the country), and finally, two disjoint clusters of provinces with poor facilities that shared comparable values (eastern seaboard and southern provinces). Further analysis using transportation networks may also be useful to find out how connected these provinces are.

We found that the disparities between the groups are so great that, for all variables, the worst case scenario for the group of provinces with good facilities (northern regions) is generally the best case scenario for the two disjoint clusters of provinces with poor facilities (the eastern seaboard and southern regions). Education is highly valued by Filipinos and is generally perceived as a path to escape poverty. But if the state of school facilities differs such that the worst case for one group is the best case for another, then education will be unable to achieve its supposed goal.

Results of this study should be considered in light of its limitations. First, Picus et al. (2005) pointed out the shortcomings of utilizing school facility data acquired through surveys and there is a possibility that the results may not be free from bias, e.g. the school can misuse the surveys to request for facility improvements. However, the basic assumption is that the survey results are usable because of a high survey response rate. Second, the number of classrooms instead of classroom area or capacity was utilized. Hence a classroom is evaluated against the DepEd’s recommended PCR of 45 whether it can accommodate 30 or 60 students. Third, the lack of data regarding double shifts has altered the actual ratio of students to facilities in the urban areas. The computed ratios are more accurate in provinces with fewer urban areas and further from the actual scenarios in regions like the capital with larger urban areas. Fourth, the proliferation of unisex toilets in the country limited this study from computing the actual ratio of toilets to male and female pupils. Finally, large variations in school seats and toilet data prompted the use of median values instead of the mean.

**Conclusions**

We investigated the condition of education facilities among 75 provinces in the Philippines. We analysed various indicators simultaneously by employing regionalization methods in addition to global and local statistics. The cluster analysis and regionalization algorithms utilized in the present paper have identified four clusters of provinces with comparable building conditions. The findings contribute to the understanding of education resource allocation in the Philippines in terms of geographic distribution as well as the disparities in education facilities between clusters of provinces.

The results of this study show that school building quality in the Philippines is affected by geography, climate and societal conditions. School buildings in the country’s eastern seaboard (which is exposed to the Pacific Ocean and prone to natural disasters) are poor, compared to the buildings in relatively safe areas (e.g. northern provinces which are protected by a mountain range). Decades of civil unrest have also resulted in deteriorated education facilities in southern provinces.

As we found, geographic and social factors beyond the control of the local school boards affected the physical condition of the school buildings, therefore the national gov-
ernment has to address these issues in order to minimize the disparities and provide equal access to education. The proposed reallocation of education resources that is relative to the current state of a province is shown to mitigate the situation by eliminating disparities caused by the natural and social environment but not the ones caused by overpopulation. Hence, we recommend the government to invest more resources in the maintenance and upgrade of school buildings that are prone to degradation caused by environmental calamities or disordered communities in order to reduce the disparity between provinces.

**Future studies**

Future studies can look into the effects of school sanitation facilities on education outcomes as well as its effects on the local community’s health. There is also a need to establish the extent of the influence of provincial income on school building conditions in the case of the Philippines. It will be interesting to find out whether the alarming need for public school facilities across the country will be solved in due time by the recent increase in the government’s education budget. Nevertheless, we acknowledge that an increase in funding does not always solve the problem because non-financial factors may also affect the allocation of education resources as the ability to utilize assets is crucial to solve disparities in decentralized education systems.

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**Notes**

1. Although this has been the highest allocation for education in the Philippines for more than 15 years, it still falls short of the UNESCO standard of 6%.
2. Including the Dinagat Islands.
3. Number of required classrooms = \( \frac{\text{enrollment}}{90} - \text{available classrooms} \)

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## Appendix

### Administrative Divisions Frequency Distribution of Variables

| Region                          | Province | Building Conditions | Classrooms | Seats | Toilets | Total Students | Total Schools | Building Condition (Mean) | Students per Classroom | Students per Seat (Median) | Students per Toilet (Median) |
|---------------------------------|----------|---------------------|------------|-------|---------|----------------|---------------|--------------------------|------------------------|----------------------------|----------------------------|
| **Cordillera Administrative Region (CAR)** |          |                     |            |       |         |                |               |                          |                        |                            |                            |
| 1 Abra                          |          | 77%                 | 74%        | 67%   | 49%     | 40,995         | 310           | 1.77                     | 23                     | 0.64                       | 46                         |
| 2 Apayao                        |          | 64%                 | 62%        | 55%   | 49%     | 22,833         | 190           | 1.74                     | 31                     | 0.87                       | 34                         |
| 3 Benguet                       |          | 64%                 | 64%        | 34%   | 42%     | 128,202        | 488           | 1.69                     | 29                     | 0.97                       | 50                         |
| 4 Ifugao                        |          | 86%                 | 86%        | 75%   | 59%     | 34,927         | 257           | 1.63                     | 25                     | 0.77                       | 52                         |
| 5 Kalinga                       |          | 78%                 | 78%        | 55%   | 42%     | 43,092         | 282           | 1.70                     | 44                     | 0.88                       | 60                         |
| 6 Mountain Province             |          | 57%                 | 56%        | 47%   | 40%     | 31,643         | 258           | 1.67                     | 21                     | 0.69                       | 51                         |
| **National Capital Region (NCR)** | 7 Metropolitan Manila |                     |            |       |         |                |               |                          |                        |                            |                            |
| 8 Ilocos Norte                  |          | 96%                 | 95%        | 91%   | 85%     | 1,999,041      | 734           | 1.47                     | 91                     | 1.66                       | 176                        |
| 9 Ilocos Sur                    |          | 31%                 | 30%        | 25%   | 25%     | 120,196        | 549           | 1.68                     | 30                     | 1.06                       | 28                         |
| 10 La Union                     |          | 95%                 | 96%        | 89%   | 82%     | 134,576        | 418           | 1.73                     | 26                     | 1.01                       | 34                         |
| 11 Pangasinan                   |          | 89%                 | 88%        | 79%   | 71%     | 616,728        | 1,476         | 1.62                     | 34                     | 1.13                       | 41                         |
| **Cagayan Valley (Region II)**  | 12 Batanes | 96%                 | 93%        | 89%   | 93%     | 4,071          | 28            | 1.50                     | 10                     | 0.66                       | 27                         |
| 13 Cagayan                      |          | 61%                 | 63%        | 59%   | 49%     | 207,949        | 822           | 1.67                     | 27                     | 1.15                       | 41                         |
| 14 Isabela                      |          | 90%                 | 89%        | 83%   | 67%     | 279,817        | 1,116         | 1.64                     | 31                     | 0.93                       | 42                         |
| 15 Nueva Vizcaya                |          | 68%                 | 68%        | 60%   | 52%     | 82,310         | 376           | 1.68                     | 27                     | 1.13                       | 40                         |
| 16 Quirino                      |          | 93%                 | 92%        | 86%   | 54%     | 31,797         | 207           | 1.65                     | 25                     | 0.93                       | 44                         |

(Continued)
### Administrative Divisions

| Region          | Province | % of Schools with Data on | Total Students | Total Schools | Building Condition (Mean) | Students per Classroom (Mean) | Students per Seat (Median) | Students per Toilet (Median) |
|-----------------|----------|---------------------------|---------------|---------------|---------------------------|------------------------------|-----------------------------|-----------------------------|
| **Central Luzon** |          |                           |               |               |                           |                              |                             |                             |
| (Region III)    |          |                           |               |               |                           |                              |                             |                             |
| 17              | Aurora   | 97% 96% 84% 70%          | 40,743        | 165           | 1.65 29                   | 1.04                         | 46                          |                             |
| 18              | Bataan   | 91% 92% 91% 86%          | 141,781       | 219           | 1.45 46                   | 0.95                         | 53                          |                             |
| 19              | Bulacan  | 97% 97% 86% 84%          | 532,749       | 603           | 1.49 56                   | 1.15                         | 58                          |                             |
| 20              | Nueva Ecija | 94% 78% 41% 63%        | 396,930       | 894           | 1.74 44                   | 1.08                         | 57                          |                             |
| 21              | Pampanga | 92% 92% 88% 80%          | 419,965       | 669           | 1.55 36                   | 1.08                         | 42                          |                             |
| 22              | Tarlac   | 81% 61% 75% 65%          | 238,534       | 585           | 1.65 43                   | 1.09                         | 51                          |                             |
| 23              | Zambales | 91% 90% 86% 84%          | 163,862       | 336           | 1.70 33                   | 1.15                         | 50                          |                             |
| **CALABARZON**  |          |                           |               |               |                           |                              |                             |                             |
| (Region IV-A)   |          |                           |               |               |                           |                              |                             |                             |
| 24              | Batangas | 80% 79% 74% 63%          | 427,891       | 945           | 1.78 38                   | 1.07                         | 38                          |                             |
| 25              | Cavite   | 91% 92% 85% 82%          | 549,567       | 449           | 1.66 58                   | 1.06                         | 54                          |                             |
| 26              | Laguna   | 94% 94% 83% 78%          | 494,769       | 573           | 1.55 54                   | 1.04                         | 52                          |                             |
| 27              | Quezon   | 92% 93% 85% 72%          | 402,632       | 1,015         | 1.72 41                   | 1.11                         | 51                          |                             |
| 28              | Rizal    | 94% 94% 74% 67%          | 451,056       | 328           | 1.53 60                   | 1.25                         | 107                         |                             |
| **MIMAROPA**    |          |                           |               |               |                           |                              |                             |                             |
| (Region IV-B)   |          |                           |               |               |                           |                              |                             |                             |
| 29              | Marinduque | 97% 97% 90% 90%         | 58,567        | 225           | 1.61 25                   | 0.95                         | 30                          |                             |
| 30              | Occidental Mindoro | 88% 85% 83% 76% | 122,957       | 347           | 1.66 49                   | 1.33                         | 52                          |                             |
| 31              | Oriental Mindoro | 96% 96% 88% 85%     | 194,051       | 540           | 1.65 44                   | 1.19                         | 43                          |                             |
| 32              | Palawan  | 93% 94% 73% 58%          | 222,810       | 791           | 1.61 46                   | 1.10                         | 88                          |                             |
| 33              | Romblon  | 97% 97% 82% 83%          | 80,621        | 253           | 1.57 34                   | 1.02                         | 46                          |                             |
| Region                  | No. | Province          | Spending % | Spending % | Spending % | Spending % | Population | Growth Rate | Urban Population | Density |
|-------------------------|-----|-------------------|------------|------------|------------|------------|------------|--------------|------------------|---------|
| Bicol Region (Region V) | 34  | Albay             | 92%        | 90%        | 82%        | 76%        | 306,185    | 1.75        | 46               | 1.47    | 80        |
|                         | 35  | Camarines Norte   | 94%        | 94%        | 89%        | 79%        | 127,847    | 1.82        | 38               | 1.10    | 49        |
|                         | 36  | Camarines Sur     | 51%        | 49%        | 42%        | 40%        | 439,968    | 1.83        | 50               | 1.70    | 65        |
|                         | 37  | Catanduanes       | 98%        | 96%        | 86%        | 80%        | 65,256     | 1.87        | 35               | 1.19    | 71        |
|                         | 38  | Masbate           | 21%        | 14%        | 10%        | 10%        | 254,402    | 1.79        | 58               | 1.07    | 113       |
|                         | 39  | Sorsogon          | 58%        | 57%        | 54%        | 44%        | 195,209    | 1.83        | 41               | 1.25    | 61        |
|                         | 40  | Aklan             | 95%        | 95%        | 73%        | 53%        | 102,581    | 1.77        | 31               | 1.25    | 42        |
| Western Visayas (Region VI) | 41  | Antique           | 75%        | 76%        | 65%        | 62%        | 133,121    | 1.74        | 39               | 1.02    | 43        |
|                         | 42  | Capiz             | 84%        | 83%        | 67%        | 59%        | 152,197    | 1.71        | 36               | 0.96    | 52        |
|                         | 43  | Guimaras          | 97%        | 97%        | 88%        | 92%        | 35,259     | 1.71        | 27               | 0.90    | 32        |
|                         | 44  | Iloilo            | 8%         | 7%         | 7%         | 6%         | 433,551    | 1.67        | 42               | 1.26    | 46        |
|                         | 45  | Negros Occidental | 98%        | 97%        | 83%        | 64%        | 673,956    | 1.70        | 45               | 1.10    | 65        |
| Central Visayas (Region VII) | 46  | Bohol             | 95%        | 95%        | 78%        | 78%        | 247,072    | 1.76        | 40               | 1.43    | 43        |
|                         | 47  | Cebu              | 76%        | 76%        | 67%        | 61%        | 880,319    | 1.72        | 47               | 1.14    | 72        |
|                         | 48  | Negros Oriental   | 84%        | 84%        | 79%        | 68%        | 295,007    | 1.64        | 51               | 0.98    | 87        |
|                         | 49  | Siquijor          | 99%        | 97%        | 88%        | 84%        | 15,023     | 1.74        | 23               | 0.67    | 34        |
| Eastern Visayas (Region VIII) | 50  | Biliran           | 98%        | 96%        | 86%        | 83%        | 44,210     | 1.59        | 30               | 1.07    | 36        |
|                         | 51  | Eastern Samar     | 98%        | 98%        | 96%        | 77%        | 104,941    | 1.75        | 37               | 0.97    | 41        |
|                         | 52  | Leyte             | 73%        | 73%        | 65%        | 60%        | 443,427    | 1.69        | 46               | 1.13    | 47        |
|                         | 53  | Northern Samar     | 92%        | 88%        | 80%        | 52%        | 148,706    | 1.82        | 60               | 1.33    | 98        |
|                         | 54  | Samar              | 92%        | 92%        | 81%        | 55%        | 182,598    | 1.78        | 48               | 1.39    | 76        |
|                         | 55  | Southern Leyte     | 97%        | 97%        | 89%        | 85%        | 87,989     | 1.63        | 30               | 0.90    | 40        |
### Administrative Divisions Frequency Distribution of Variables Provincial Values

| Region                        | Province          | % of Schools with Data on Building Conditions | % of Schools with Data on Classrooms | % of Schools with Data on Seats | % of Schools with Data on Toilets | Total Students | Total Schools | Building Condition (Mean) | Students per Classroom (Mean) | Students per Seat (Median) | Students per Toilet (Median) |
|-------------------------------|-------------------|---------------------------------------------|-------------------------------------|---------------------------------|-----------------------------------|----------------|----------------|----------------------------|-------------------------------|-----------------------------|-------------------------------|
| Zamboanga Peninsula (Region IX) | 56                 | Zamboanga del Norte                         | 67%                                 | 64%                             | 53%                               | 38%            | 235,318       | 841                        | 1.75                          | 40                          | 1.35                          | 71                          |
|                               | 57                 | Zamboanga del Sur                           | 72%                                 | 70%                             | 56%                               | 48%            | 412,188       | 1,070                      | 1.57                          | 43                          | 1.01                          | 64                          |
|                               | 58                 | Zamboanga Sibugay Bukidnon                  | 97%                                 | 95%                             | 84%                               | 69%            | 146,611       | 494                        | 1.59                          | 50                          | 1.24                          | 77                          |
| Northern Mindanao (Region X)  | 59                 | Bukidnon                                    | 93%                                 | 86%                             | 69%                               | 69%            | 296,588       | 720                        | 1.73                          | 54                          | 1.29                          | 58                          |
|                               | 60                 | Camiguin                                    | 89%                                 | 80%                             | 75%                               | 65%            | 18,991        | 65                         | 1.72                          | 28                          | 1.20                          | 32                          |
|                               | 61                 | Lanao del Norte                             | 85%                                 | 74%                             | 21%                               | 27%            | 169,723       | 467                        | 1.88                          | 59                          | 1.15                          | 101                         |
|                               | 62                 | Misamis Occidental                          | 80%                                 | 71%                             | 61%                               | 48%            | 111,990       | 513                        | 1.80                          | 29                          | 1.03                          | 40                          |
|                               | 63                 | Misamis Oriental                            | 98%                                 | 93%                             | 74%                               | 68%            | 302,002       | 604                        | 1.62                          | 43                          | 1.13                          | 49                          |
| Davao Region (Region XI)      | 64                 | Compostela Valley                           | 71%                                 | 70%                             | 58%                               | 53%            | 149,743       | 383                        | 1.52                          | 46                          | 1.01                          | 52                          |
|                               | 65                 | Davao del Norte                             | 91%                                 | 89%                             | 78%                               | 69%            | 198,565       | 358                        | 1.57                          | 41                          | 1.18                          | 57                          |
|                               | 66                 | Davao del Sur                               | 90%                                 | 89%                             | 78%                               | 71%            | 477,835       | 811                        | 1.66                          | 48                          | 1.32                          | 76                          |
|                               | 67                 | Davao Oriental                              | 54%                                 | 54%                             | 51%                               | 44%            | 129,226       | 360                        | 1.68                          | 39                          | 1.09                          | 52                          |
|   | Province/Region | Percentage | Population | Housing Units | Density (ppl/km²) | Gini Coefficient | HHH | Population Growth Rate |
|---|----------------|------------|------------|---------------|-------------------|-----------------|-----|-----------------------|
| SOCCSKARGEN (Region XII) | North Cotabato | 43% | 44% | 41% | 36% | 290,311 | 807 | 1.73 | 55 | 1.17 | 62 |
| 69 | Sarangani | 86% | 85% | 67% | 62% | 122,193 | 249 | 1.75 | 74 | 1.16 | 92 |
| 70 | South Cotabato | 95% | 93% | 76% | 74% | 285,587 | 475 | 1.59 | 48 | 1.66 | 53 |
| 71 | Sultan Kudarat | 88% | 85% | 84% | 58% | 137,061 | 387 | 1.76 | 49 | 1.17 | 63 |
| Caraga (Region XIII) | Agusan del Norte | 95% | 92% | 71% | 75% | 150,148 | 346 | 1.68 | 46 | 1.29 | 53 |
| 72 | Agusan del Sur | 83% | 79% | 85% | 71% | 158,122 | 501 | 1.66 | 49 | 1.02 | 54 |
| 73 | Surigao del Norte (including Dinagat Islands) | 89% | 89% | 76% | 73% | 141,909 | 539 | 1.79 | 39 | 1.06 | 44 |
| 74 | Surigao del Sur | 71% | 64% | 81% | 61% | 134,874 | 515 | 1.58 | 43 | 1.18 | 41 |
| TOTAL | | | | | | 18,258,340 | 42,797 | | | | |