

A GIS Analysis on the Proximity of Crime Locations to Public Elementary Schools in Cantilan, Surigao Del Sur, Philippines

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Abstract: Schools are “safe haven” for learners. Creating a safe school climate and environment promotes social and creative learning. Unfortunately, even in schools heinous crime happens. This study was conducted to map, identify and calculate the proximity of the occurrence of police recorded crimes to the locations of elementary schools in Cantilan, Surigao del Sur. This study employs the use of GIS as a method for analysis and calculation using police recorded data from 2016-2019. Results revealed that the months of January, September, August, December and May found to be months were crimes occur. These crimes happens between 3:00-7:00 PM. Data also revealed that the distance of elementary schools from the crime incidence was measured within 1 to less than 1 kilometer. The research is the first to analyze the proximate distance of police recorded crimes to elementary schools in the Municipality of Cantilan, and so it is hoped that this can serve as a meaningful guide to school administrators, peace keepers and policy makers to improve school-based crime prevention and safety measures

Keywords: GIS, crimes, elementary schools, proximity, locations

1. Introduction

The Department of Education (DepEd) is an executive department of the Philippine government responsible for ensuring access to, promoting equity in, and improving the quality of basic education (DepEd, 2020).

Unfortunately, the schools under the Department of Education, teachers and students are becoming unsafe even inside their classrooms. On October, 2018, a 23-year old elementary teacher from Albay province was raped while staying inside the teachers cottage. Another incident in Albay on October, 2018 were a teacher was stabbed by a student during her class. While on September 2014, four (4) teachers were killed in a shooting incident inside the school campus in Lingayen, Pangasinan. On the other hand, a teacher was also shoot inside her classroom and wounded a pupil in Bulacan. Also, a grade-7 students was shoot dead inside their classroom at Calamba, Laguna on July, 2019. These incidents were not exemption in Surigao del Sur province, were an Indigenous Peoples school director in Lianga was killed on September, 2015. This only shows how vulnerable schools are to different crimes even inside the school premises.

This study focuses on the examination of the proximate distances of the crime occurrence that will help define the vulnerability of the schools to potential crimes. By plotting and analyzing police recorded incidents of drugs, murder, homicide, violation on the comprehensive law on firearms and ammunition, theft and robbery as crimes in relation to the location of public elementary schools, it can be easier to identify which school is proximate to crime incidence in the town. The research is the first to analyze the proximate distance of police recorded crimes to schools location in the Municipality of Cantilan and so it is hoped that this can serve as a meaningful guide to school administrators and policy makers to improve school-based crime prevention and safety measures.

2. Background Literature

Cloete and Stevens (1996) define crime as an unlawful act or omission which is either a prohibition or behaviour which is punishable by authorities. While according to Snyman (Cf. 2002) crime is unlawful, blameworthy conduct punishable by law. In the Philippines, one of the priorities of local law enforcement is crime reduction and avoidance and as stated in the Philippine National Development Plan 2017 – 2022, national security and public order are essential elements in building the foundation for inclusive growth, a high trust and resilient society, and a globally competitive knowledge economy. Statistically, crime is those reported violations to authorities are covered.

Philippine National Police (PNP) has defined crime classification as an index and non-index crimes. A crime is classified as index or non-index. Indexed crimes are those sufficiently significant and which occur with sufficient regularity which is divided into two (2) categories; crimes against person such as murder, homicide, physical injury and rape, and crimes against poverty such as theft and robbery.

Many researchers have examined the consequences of crime related violence to education, how school activities have been suspended because of crime occurrence within the vicinity of the school. According to the National Survey on Victimization and Public Security Perception (2012), 28 percent of the population feels unsafe in the surroundings of educational institutions. Even if students and educators do not experience crime and violence first-hand, the perception of insecurity or fear of crime is a mounting preoccupation for schools and families. In 2009, police crime reports reveal that more than one hundred schools, colleges and universities are located within the crime hot spots in the Philippines (NCRPO, 2009). This shows a clear testament that school children are facing dangers outside the comfort of their classrooms.

One of the earliest theories that can link the vulnerability of elementary schools, specifically school children and occurrence of crime is the Routine activities theory developed by Cohen and Felson (1979), routine activities theory requires three elements be present for a crime to occur: a motivated offender with criminal intentions and the ability to act on these inclinations, a suitable victim or target, and the absence of a capable guardian who can prevent the crime from happening. These three elements must converge in time and space for a crime to occur. In the case of public elementary schools, children become vulnerable after class hours whenever their parents/guardians are not there to fetch them after classes.

Felson and Cohen (1980) postulate that criminal activities are a “structurally significant phenomenon,” meaning that violations are neither random nor trivial events. Crime is therefore normal and is dependent on available opportunities to offend. If there is an unprotected target and there are sufficient rewards, a motivated offender will commit a crime. In 2008, Korca et.al., using Space Syntax, observed that outdoor crimes on a campus are committed close to buildings and roads where movement and potential victims are more.

3. Data And Study Area

The site under study are the public elementary schools in Cantilan, Surigao del Sur (Fig.1).

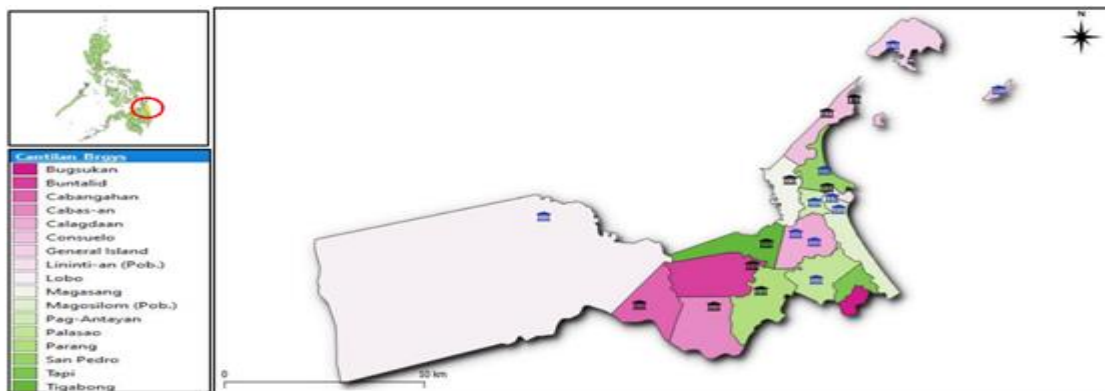


Figure 1. Distribution of Schools in the Barangays of Cantilan, Surigao del Sur

From 2016 to 2019 a total of 91 on drugs, comprehensive firearms and ammunition, murder, homicide, theft and robbery have been recorded by the Cantilan Municipal Police Station. Of the 91 cases, 21 are drug related or violation on R.A.9165, 29 are murder cases, 18 are violation on comprehensive law on firearms and ammunition, 8 are homicide cases, while 15 are left to theft and robbery. Statistics shows that violation on R.A. 9165 or Comprehensive Dangerous Drugs Act of 2002 were committed outdoors. Of these, 15 cases happened along streets, while violation on Comprehensive Law on Firearms and Ammunition occur more on indoors than outdoors. This supports the conclusion of Long and Baran that outdoor campus crimes happen near buildings and roads. Most crimes were recorded highest within the months of January, September and December. Most of the suspects of the crimes are male although in drug related case, some female are also involved. These crimes usually occur within the vicinity of public elementary schools in less than kilometer distance. Thus, imposing a threat to young school children.

4. Methodology

Data on crime were obtained from Cantilan Municipal Police Station, while the administrative boundary maps of school locations and barangays of Cantilan were produced using the QGIS 3.12 Software. The GIS maps were mainly used in the analysis which revolve around (1) calculating distance of schools location to the occurrence of crimes, and (2) identifying elementary schools which are very proximate to the occurrence of crimes. The distance of crime occurrence and school location were established by means of graph comparison. The distance of schools to the nearest crime occurrence were calculated using the azimuth and distance calculation function in the QGIS.

5. Results And Analysis

Summary of Monthly Police Recorded Crimes

From 2016-2019 police recorded crimes showed that the months of January, September and December have the highest recorded crimes. While from 2016-2019 crimes have been decreasing in the Municipality of Cantilan.

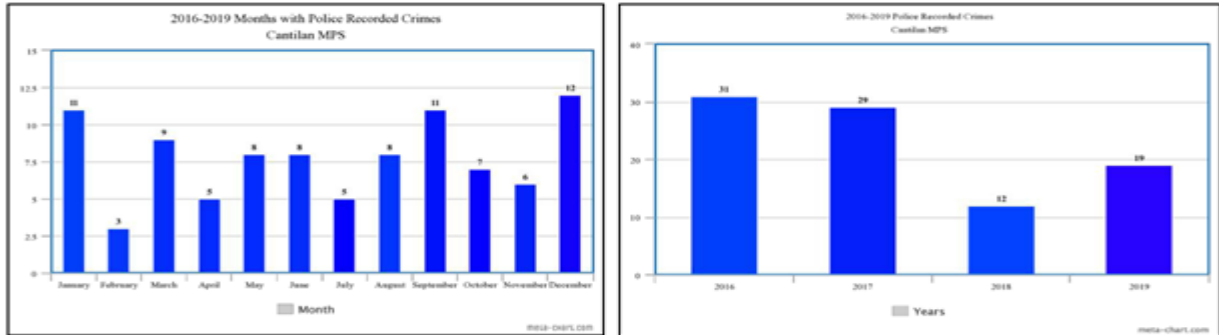


Figure 2. 2016-2019 Monthly Summary of Police Recorded Crimes (A), 2016-2019 Recorded Crimes (B).

Monthly Police Recorded Crimes

Data in Figure 3 below shows the crime occurrence from 2016-2019 per month. In 2016, crimes committed were higher in the months of January and September, while in 2017, crimes were higher in August and December. Moreover, in 2018 crimes were highest in the month of September and in 2019 May has the highest police recorded crimes.

The month of August is the annual fiesta celebration of the municipality were in volume of people are expected. While May is the month where almost every other day, most of the barangays of Cantilan is celebrating their patron saints. This shows that criminals perpetuate in crowded areas where people are busy during celebrations.

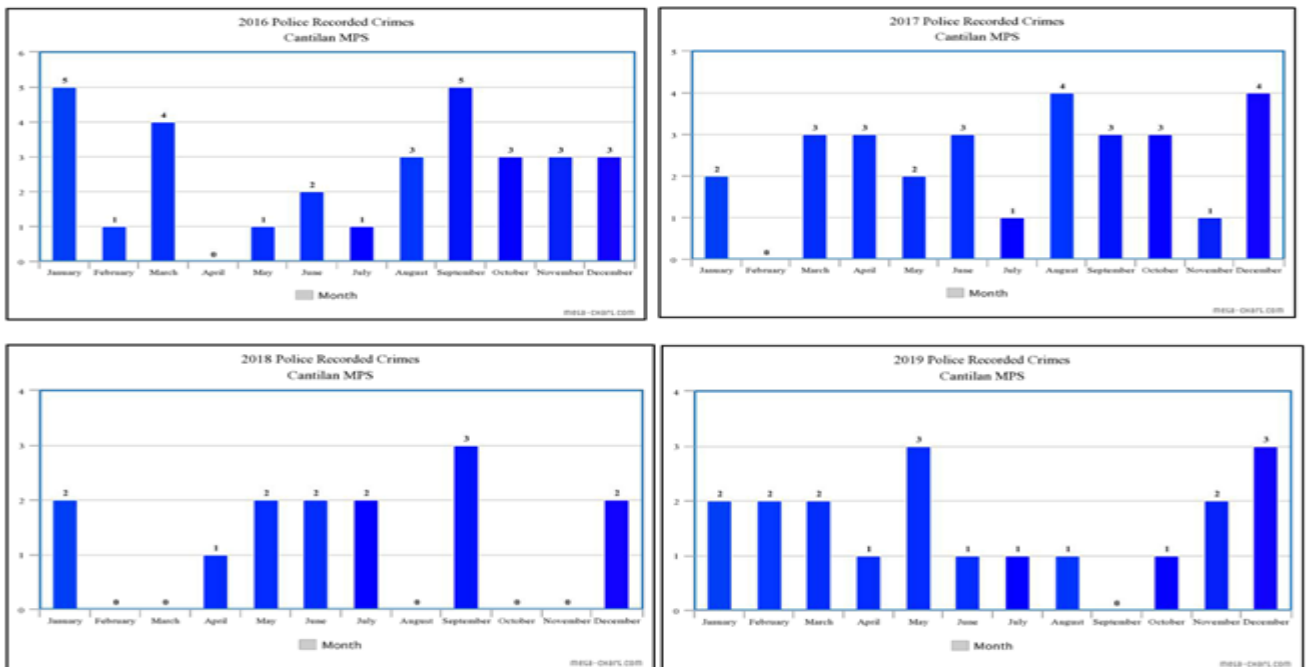


Figure 3. Monthly Police Recorded Crimes , (A) 2016, (B) 2017, (C) 2018, and (D) 2019

Time crimes were committed

Figure 4 below shows the time different crimes were committed. In terms of drug related crimes, data shows that they are committed highest at 3:00 PM , homicide were committed at 6:00 PM , theft and robbery at 4:00 PM , violation on comprehensive law on firearms and ammunition at 5:00 AM , and murder at 7:00 PM. Contrary to a popular belief, that criminals mostly perpetrate crimes during late hours of the evening and even during the wee hours.

The peak hours of committing crimes such as drugs, theft and robbery are considered to be school hours especially during weekdays. While result of time where homicide are usually committed are time where some teachers are still in the school whenever they have extra paper works that needs to be done, after office hours.

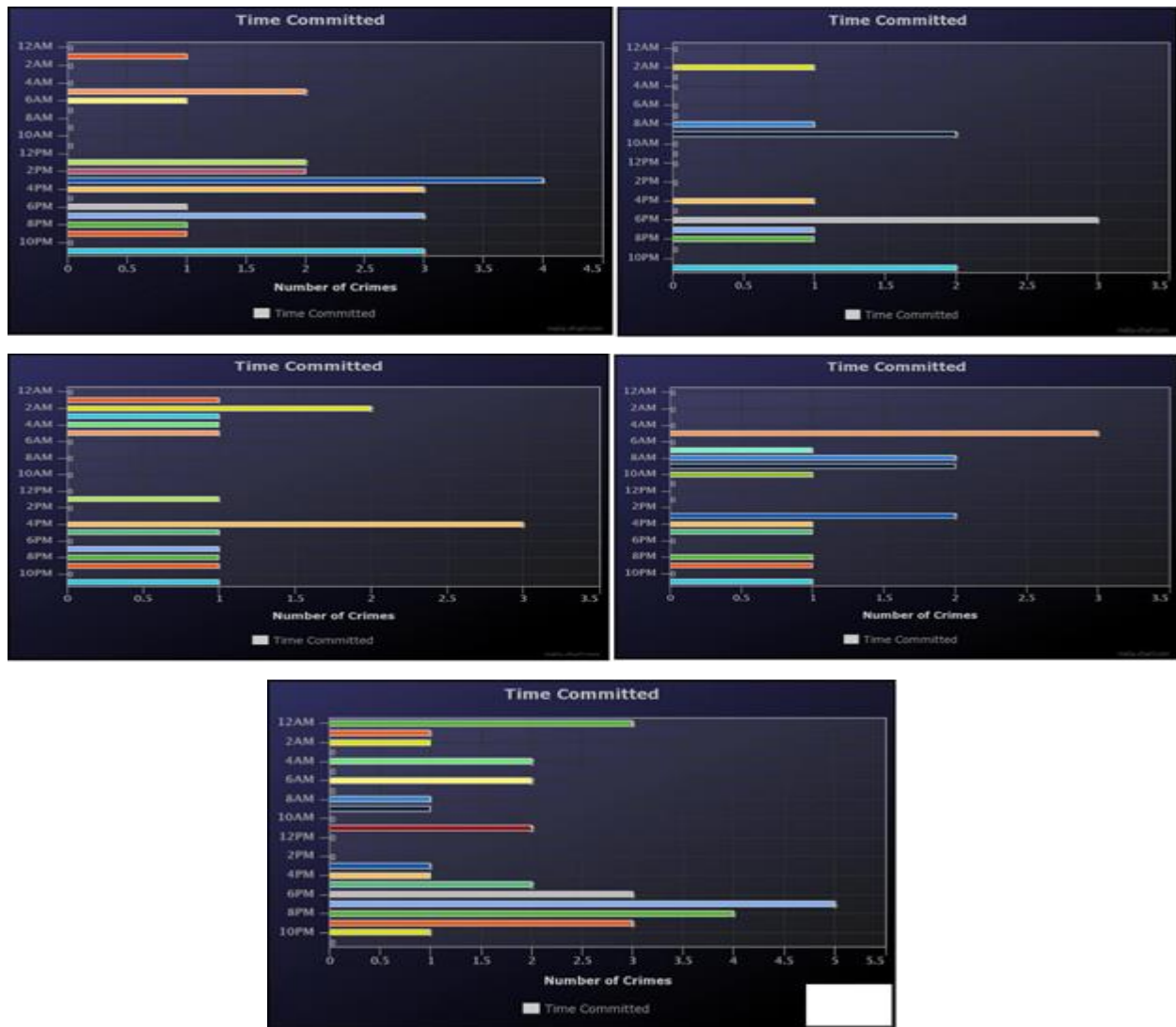


Figure 4. Bar graph showing the distribution of time crimes were committed from 2016-2019. (A) Violation on Dangerous Drugs Act of 2002 , (B), Homicide , (C) Theft and Robbery , (D) Violation on Comprehensive Law on Firearms and Ammunition, and (E) Murder.

Hot spots of crimes and elementary school locations

A hot spot is an area of concentrated crime (Eck , 2005). where people have a higher than average risk of victimization. The map below (Fig.4) shows the overall hot spots for the four-year period. There are four elementary schools which are very near to the crime occurrence ;

Cantilan East Central Elementary School, (2) Cherry Coletto Elementary School , (3) Nazaria Arizobal Memorial Elementary School (NAUMES) and (4) Calagdaan Elementary School. These schools are located along the streets where accessibility is very easy. This result is supported by the work of Brantingham & Brantungham (1995) shows that the hot spots by the type of committed crime; thus, for example, robberies are most commonly committed in sports centers, youth centers, restaurants, and laundries.

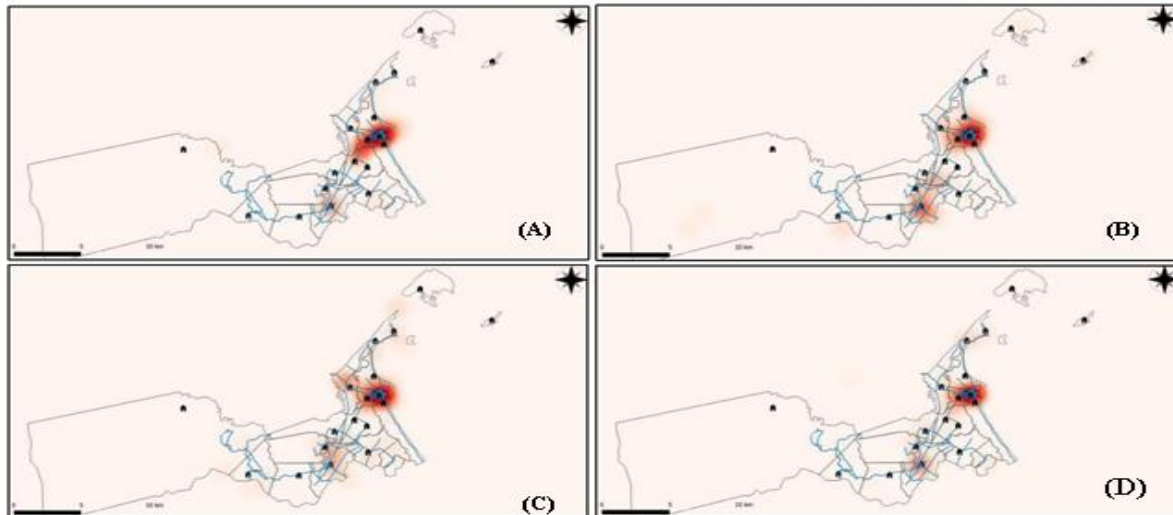


Figure 4. Hot spots of crime occurrence and location of schools (A) 2016, (B) 2017, (C) 2018, and (D) 2019.

Proximate Distance of Police Recorded Crimes to Elementary Schools Comprehensive Dangerous Drugs Act of 2002

Drugs are related to crime in multiple ways. Most directly, it is a crime to use, possess, manufacture, or distribute drugs classified as having a potential for abuse (U.S. Department of Justice, 1994). A growing body of research shows that exposure to neighborhood violence negatively affects academic performance (Schwartz et al. 2016). School climate may also affect the academic performance of students (Thapa et al. 2013). In 2016, there were ten (10) police recorded cases of drug related incidence in the Municipality of Cantilan. All these incidents fall within and less than 1 km distance from a public elementary schools. The nearest is to Calagdaan Elementary School with a proximate distance of 220.07 m from the area where the crime occurs. Followed by 253.34 m from Cantilan East Central Elementary School and 283.86 m from Cantilan Pilot School (Tab.1). In 2017, there were seven (7) drug related incidence which has an proximate distance of 41.78m from Nazaria Arizobal Uriarte Memorial Elementary School, and 86.19 m from Magasang Elementary School. While in 2018, Cantilan Police Station has a record of two (2) drug related incidence which has a proximate distance of 398.96 from Cantilan Pilot School and 617.08 m from Parang Elementary School. Furthermore, in 2019 three (3) drug related cases were recorded which has a proximate distance of 107.29 m from Nazaria Arizobal Uriarte Memorial Elementary School, 332.61m from Cantilan Pilot School and 452.7 m from Cantilan East Central Elementary School. The data only shows how close the drug related incidence to public elementary schools in Cantilan, with a proximate distance of less than a kilometer. Although, dimensions of school climate may affect youth differently depending on their racial and ethnic background or gender (Lacoe, 2016).

Table 2. Proximate Distance of Drug -Related Incidence to Elementary Schools

Name of Schools	Proximate Distance to the Crime Incidents (m)			
	2016	2017	2018	2019
Cherry Coletto Elementary School	1240.62	1141.48		
	861.02	856.07		
	1184.3	140.34		
Cantilan Pilot School	408.75		398.86	
Cantilan East Cental Elementary School	283.86	449.75		332.61
	324.98			
	253.34			
Nazaria Arizobal Elementary School	320.19	41.78		107.29
	498.36	738.05		
Magasang Elementary School		86.19		

Parang Elementary School	617.08
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Name of Schools	Proximate Distance to the Crime Incidents (m)			
	2016	2017	2018	2019
Nazaria Arizobal Elementary School	516.12	35.63		244.96
	511.63	736.1		
Bugsukan Elementary School	964.67			
Parang Elementary School	184.08	684.48		486.12
Cherry Coletto Elementary School		1382.09		
Cabangahan Integrated School		976.25	1110.9	
Magasang Elementary School			534.	
Cantilan East Central Elementary School			442.8	127.56
				221.82
				400.10
Buntalid Elementary School				287.99

Comprehensive Law on Firearms and Ammunition

In terms of crimes committed on the comprehensive law on firearms and ammunition, data shows that in 2016 Parang Elementary schools shows to be the nearest school at a distance of 184.08 m to the occurrence of the crime. While in 2017, Nazaria Arizobal Uriarte Memorial Elementary School (NAUMES) shows a distance of 35.63 m from crime occurrence. Furthermore, in 2018 Magasang Elementary School has a proximate distance of 442.8 m and in 2019 at 127.56 m respectively.

Table 3 below shows the proximate distance of elementary schools to the nearest incidence of firearms and ammunition.

Table 3. Proximate Distance of Incidence on Violation on Comprehensive Law on Firearms and Ammunition to Elementary School

According to Brymer M, et.al., (2012) , shootings that tend to occur in schools neighborhoods already besieged by violence and where schools are commonly viewed as a “safe haven” within more dangerous areas. When external violence invades the school, the community loses that safe sanctuary for learning and camaraderie. In addition, the effects of school shootings go beyond the schools and those attending or working there. Regardless of whether a shooting occurs in a community with high crime and violence or in a community that is historically safe and stable, school shootings have lasting ramifications for each family and also impact relationships among community members including parents, the school, law enforcement, and local government (Berkowitz,et.al., 2010).

Homicide

Researchers at John Hopkins University stressed out that schoolchildren exposed to neighborhood violence can have a tougher time learning, experiencing more stress and depression than their peers growing up in safe neighborhoods.

Homicide cases though occurs usually at 6:00 PM based on the police recorded data, could still potentially affect school teachers and staff who would stay longer at school and do overtime paper works. Table 3 below shows the proximate distance of homicide incidence to elementary schools in Cantilan. In 2016, Buntalid Elementary School has an approximate distance of 65.16 m from the homicide incidence, while in 2017 at a proximate distance of 143.95 m, from Nazaria Arizobal Uriarte Memorial Elementary School another incidence of homicide was recorded. Also, in 2019 Tigabong Elementary School has an approximate distance of 464. 51 m from crime incidence. It can be noted that all the point coordinates of the recorded crimes has an approximate distance of 1 to less than 1 km from the the elementary schools.

Table 4 below shows the proximity of elementary schools to the nearest incidence of homicide in the town. Crime naturally goes against the established social rules, which can prevent things in a school from functioning

Name of Schools	Proximate Distance to the Crime Incidents (m)			
	2016	2017	2018	2019
Nazaria Arizobal Uriarte Memorial Elementary Schools	239.59	143.95 608.95		
Buntalid Elementary School	65.16			
Parang Elementary School	299.57			
Palasao Integrated School		1092.96		
			1876.37	
Bugsukan Elementary School				
Tigabong Elementary School				464.51

properly. While school is considered a learning community, instability within the community also shapes the behaviour of the learners (Leoschut, 2008). Instability means lack of stability (Schwartz & Hopmeyer Gorman, 2003).

Table 4. Proximate Distance of Homicide Incidence to Elementary Schools

Murder

Murder is a heinous crime, when it is present in the community school climate and functioning will eventually be affected. Exposure to violent crime can damage people’s health and development (Sahrkey, et.al, 2015) and violence can push communities into vicious circles of decay. Table 4 below shows that from 2016-2019, murder incidence occur within the range of 42.62 m to 8919.41 m from elementary schools. In 2016, there were eight (8) recorded crimes of which the closest distance to an elementary school measures 131.43 m from Cantilan East Central Elementary School, while in 2017 Ayoke Elementary School, which is a school located in one of the

Name of Schools	Proximate Distance to the Crime Incidents (m)			
	2016	2017	2018	2019
Cherry Coletto Elementary School	1348.21	429.58	1455.56	1266.86
Cantilan East Central Elementary School	193.49	141.94	372.35	
	131.43	162.54		
	473.33	173.03		
Calagdaan Elementary School	1053.99			620.71
Parang Elementary School	484.46	150.84		1063.96
	768.87	1198.93		367.69
Lobo Elementary School	2542.56	8919.41		
Simeon Beltran Elementary School		422.08		
Palasao Integrated School		628.04		
Ayoke Elementary School		42.62		
Cabangahan Integrated School			1372.44	
Consuelo Elementary School			852.35	
Nazaria Arizobal Memorial Elementary School			278.36	
			411.45	181.09
				1433.45
				1463.81

islands of Cantilan has an approximate distance of 42.62 m from the crime occurrence. Also in 2018 , 372.35 m is

the proximate distance of the crime to Cherry Coletto Elementary School and 181.09 m from Buntalid Elementary School respectively.

Table 5. Proximate Distance of Murder Incidence to Elementary Schools

Theft and Robbery

Theft is defined as the physical removal of an object that is capable of being stolen without the consent of the owner and with the intention of depriving the owner of it permanently (Encyclopedia Britannica). While robbery is an aggravated form of theft that involves violence or the threat of violence against a victim in his presence.

There were five (5) elementary school locations which has an approximate distance ranging from 133.05 m to 1531.2 m where theft and robbery crimes commonly occurs from 2016-2019. The closest distance of the occurrence recorded was in Cherry Coletto Elementary School and Cantilan East Central Elementary School.

Table 6. Proximate Distance of Theft and Robbery Incidence to Elementary Schools

Name of Schools	Proximate Distance to the Crime Incidents (m)			
	2016	2017	2018	2019
Parang Elementary School	187.43			
Cantilan East Central Elementary School	262.59			
	142.64			
	424.91			
	285.14			133.05
				241.58
Cherry Coletto Elementary School		1355.91	1531.2	
Cantilan Pilot School		157.97		
		243.79		
		265.25		
		168.76		
Buguskan Elementary School			498.47	

6. Conclusion

GIS Analysis provides a useful approach in calculating the proximate distance of crime occurrence from the schools location, as it brings about the schools near to crime hot spot. While elementary schools are generally within 1 to less than 1 km from the crime incidence, school administrators and peace keepers can work together to help promote safe school learning by conducting regular and serious public education campaigns , to parents and the community as well.

There is so much more to be explored in the area of study of crime and education. Further research is encouraged, particularly of localized settings. The ultimate goal of this paper is not merely to for awareness campaign but to help create and promote safer schools, and peaceful community that contributes to the holistic development of every school children.

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