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School-based Information and Education Campaign (IEC) Program and Knowledge Gain of Student Participants on Rabies in a Private School in Davao City, Philippines

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Rabies is a viral disease transmitted to humans through the bite of a rabid animal, commonly from dogs. In Davao City, Philippines, many of the dog bite victims are children below 15 yr old. To educate the city's vulnerable age group on rabies, the City Veterinarian's Office (CVO) conducted a school-based information and education campaign (IEC). In this paper, we assess the knowledge gain on rabies of the student participants aging 6–19 yr old after participating in the CVO's school-based IEC program by comparing their pre-test, post-test, and retention test scores. We also identified socio-demographic drivers that are related to the student participant's rabies knowledge scores. Observations coming from 367 student participants were analyzed. Our results show that 294 student participants scored higher in the post-test than in the pre-test, but 213 student participants scored lower in the retention test than in the post-test. Nevertheless, 264 student participants still had a higher retention test score than the pre-test score. Furthermore, the student participant's age and whether he or she received a human rabies vaccination, the head of the household's gender, educational attainment, and monthly income, and the CVO's IEC lecture are significantly associated with the knowledge score to rabies. Even though CVO's school-based IEC lecture is positively associated with rabies knowledge, this paper recommends that rabies education be integrated into classroom instructions to ensure knowledge retention among student participants. Furthermore, developing age-specific IEC media for students and IEC reinforcement through text messaging are recommended as well.

Keywords: knowledge, panel regression, rabies repeated measures, school-based campaign

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INTRODUCTION

Rabies, a tropical zoonotic disease caused by the genus Lyssavirus, contributes to an average of 59,000 human deaths each year in Asia and Africa (Hampson *et al.* 2015; Rupprecht *et al.* 2017). Although rabies-induced human death can be entirely prevented through human and dog vaccinations, rabies control is often hindered due to the lack of awareness about rabies preventive healthcare and appropriate action among the general public residing in developing countries (Coleman *et al.* 2004). Ninety-five percent (95%) of the reported human rabies cases are due to dog bites with children below 15 yr of age being more susceptible than the rest of the age groups (Patle and Khakse 2014; Wunner and Briggs 2010). The dog-bite cases among children can be linked to their curiosity, playfulness, and limited knowledge regarding dogs and rabies (Eke *et al.* 2015; Ogundare *et al.* 2017; Chen *et al.* 2018).

In 2016, the World Health Organization, the World Organization for Animal Health, and the Food and Agriculture Organization jointly implemented a program, Zero-by-30, aimed to eliminate dog-mediated rabies incidents by 2030 (Wallace *et al.* 2017). In fact, several Asian and African countries have been conducting local studies on the knowledge, attitudes, and practices (KAP) to determine the individuals' knowledge of rabies and their respective preventive actions towards its infection. In Tanzania, only 5% of individuals living in affected communities knew that washing the dog bite wounds as an immediate action can prevent/slow down rabies infection (Sambo *et al.* 2014). In Cambodia, 48% of the respondents knew that vaccinations could protect humans and dogs from acquiring rabies (Lunney *et al.* 2012). In Sanur, Indonesia, KAP respondents/participants displayed good knowledge about rabies (Hilby *et al.* 2018). About 40% of the KAP respondents/participants were able to identify excessive saliva and drooling as rabies symptoms and 19% correctly identified that avoiding light is also a symptom of rabies infection to dogs. Moreover, Kanda *et al.* (2015) found out that IEC materials such as lectures and brochures are effective means of communicating preventive ways against rabies infection. Student-respondents in Sri Lanka displayed more correct responses in their assessment tests after engaging in lectures and receiving brochures. However, one KAP study in Cambodia with respondents coming from urban and peri-urban provinces revealed an alarming result as remarked by Lunney *et al.* (2012). None of the respondents were able to identify that death is an outcome of rabies infection to the dog.

In the Philippines, rabies is prevalent as the country holds a spot in the top 10 countries for human rabies deaths ranging from 200–300 annually (Davlin *et al.* 2014; Miranda *et al.* 2017), with dogs as the major rabies reservoir (Lachica *et al.* 2020). Most of the rabies exposures in the country were recorded to have occurred among children and adolescents (Deray *et al.* 2018). In this regard, the National Rabies Prevention and Control Program (NRPCP) in collaboration with the Department of Agriculture (DA) and Department of Education (DepEd) recommended that IEC sessions be conducted as a cost-efficient intervention to achieve a rabies-free Philippines by 2022 (DOH 2012). A handful of KAP studies have been conducted in different regions and cities in the Philippines in assessing the impact of NRPCP's school-based campaigns and community awareness. In Bohol, a first-class province with three congressional districts, only 18% of the 460 households were able to identify that reporting a suspected rabid dog to authorities for surveillance purposes is important (Davlin *et al.* 2014). In El Nido, on the other hand, a first-class municipality of the province of Palawan, the proportion of rabies-knowledgeable students increased after the conduct of awareness campaigns inside school campuses (Deray *et al.* 2018).

In another setting, the health authorities in Davao City, a highly urbanized city, implemented the Intensified Rabies Control Program (IRCP) (Lachica *et al.* 2019) that aims at achieving the 2022 rabies-free goal. Despite the efforts of the Davao CVO in implementing the IRCP, an increasing trend was noticed in the annual reports of the animal rabies cases in the last five years: 12 cases in 2015, 15 cases in 2016, 21 cases in 2017, 51 cases in 2018, and 29 cases in 2019 (Davao CVO; pers. comm. 09 Feb 2020), hence challenging the rabies-free goal of the city. Furthermore, Evangelio *et al.* (2020) found that in Davao City, individuals belonging in the 5–14 yr age group – comprising approximately 30% of the city's population (PSA 2017) – contribute to the majority of the dog bite cases. As a matter of fact, the presence of an individual belonging to the 5–14 yr age group increases the chance of a dog bite incident within a household (Buso *et al.* 2016; Evangelio *et al.* 2020). Thus, to reach the city's vulnerable age group to rabies incidents, the CVO partners with various elementary and secondary high schools to conduct school-based education awareness programs (Davao CVO; pers. comm. 23 Jan 2020).

Acquired knowledge, when not emphasized or reiterated during class discussions (Barroga *et al.* 2018), tends to diminish and this poses a challenge to younger students when it comes to applications of their learnings from IEC sessions. When students can recall information and then respond appropriately to circumstances (*e.g.* an encounter with a suspected rabid dog), knowledge retention is evident. It is, indeed, important to ensure that the acquired knowledge after the information campaign is retained (Lindsey *et al.* 2014), *e.g.* in written assessments at the minimum. Bailey *et al.* (2018) mentioned that

studies on KAP can be used to assess the effectiveness of education campaigns by comparing responses (*e.g.* knowledge scores, practices, attitudes) before and after an intervention. Furthermore, Glewwe and Muralidharan (2016) stated that the impact of education-related policies is dependent on child-specific factors.

Identification of the drivers of rabies knowledge among students is necessary as it can be used as a basis to improve the school-based IEC programs and likely make the acquired knowledge relevant and effective for students (Bailey *et al.* 2018). Typically, identification of rabies knowledge drivers can be done by performing a regression analysis with a cross-sectional approach, where data (*e.g.* knowledge score) are gathered from different individuals (or cross-sectional units) at a single point in time. However, since knowledge scores potentially vary through time (*e.g.* knowledge diminishment or knowledge increase due to a teaching approach), a panel approach is more appropriate to use, in which repeated observations over time on the same set of cross-sectional units are obtained. In this manner, the changes in the knowledge scores are taken into account when identifying significant rabies knowledge drivers. Hence, this paper aimed to determine if there was knowledge gain among the schoolchildren and pre-adolescent and older children (*i.e.* student participants) after participating in the IEC sessions. In particular, it is aimed to determine whether there exists a significant difference between the knowledge scores of the participants before, during, and one month after the IEC session. Furthermore, this paper aimed to determine which drivers are significantly associated with rabies knowledge using a panel regression model. The implications of these findings can serve as a guide for the CVO to further improve their school-based IEC programs. Furthermore, the methodology of this paper can also be used as a valuation guide by other health agencies in assessing the effectiveness of their respective school-based IEC programs and campaigns.

MATERIALS AND METHODS

Data

The secondary data in this study were collected from the Davao CVO, Philippines. The dataset includes the following information from the students who participated in the school-based IEC program of the CVO: 1) the knowledge scores on rabies, 2) the socio-demographic information, and 3) self-rated effectiveness of the IEC materials used during the school-based IEC program of the CVO. Moreover, at the time the study was conducted, the data came from one private educational institution because of the COVID-19 pandemic. The specific variable descriptions are presented in Table 1.

Statistical Methods

Differences in the knowledge scores. In this paper, the approach of Bailey *et al.* (2018) was followed in assessing the efficacy of educational activities for rabies awareness. The knowledge scores on rabies of the 367 student participants before participating in the school-based IEC program (pre-test), immediately after the program was administered (post-test), and one month after (retention test) were gathered. Friedman's test was used to assess the differences in the knowledge scores of the student participants in their tests. Furthermore, a Wilcoxon Signed-rank test was employed to identify which among the pairwise comparison of the scores exhibit significant differences (Ribeiro-Samora *et al.* 2017). All statistical analyses aforementioned were performed using PAST 3.26 (Hammer *et al.* 2001), which is an open-access software.

Drivers of the knowledge scores. In this paper, a panel regression model was applied to establish the relationship between socio-demographic drivers and the self-rated effectiveness of the IEC media (lecture, brochure, and video) to their knowledge scores. Following Baltagi *et al.* (2003), the panel regression model can be written as:

$$y_{it} = \beta_0 + x'_{it}\beta + c_i + \mu_{it} \tag{1}$$

where y_{it} is the observation of the i^{th} individual/entity at the period t. Specifically, y_{it} is the response variable and x_{it} is a k-dimensional row vector containing the drivers that predict y_{it}. β is a k-dimensional column vector of model parameters. β_0 is the constant, c_i is the effect of the time-invariant variables that have not captured by the model, and μ_{it} is the idiosyncratic error term, *i.e.* observation-specific zero-mean random-error term. From Equation 1, we posit our panel empirical model as:

$$RK_{it} = \beta_0 + \sum_j \beta_j x_{it}^j + c_i + \mu_{it} \tag{2}$$

where RK_{it} represents the rabies knowledge scores of the i^{th} individual on test t ($t = 1$ for pre-test, $t = 2$ for post-test, and $t = 3$ for retention test). Note that the subscript variable t here can be regarded as a time period. Moreover, x_{it} is the numerical information of driver j (*e.g.* socio-demographic drivers, self-rated effectiveness of IEC media), the constant β_0 and coefficients β_j are the parameters to be estimated. The socio-demographic drivers included were the student's age, gender, religion, ethnicity, the head of household's educational attainment and gender, and the household's monthly income. Furthermore, since the values of the drivers are invariant across the three time periods, Equation 2 was estimated using the random-effects model (Baltagi *et al.* 2003). The estimation of the model parameters was performed using Stata 15.1.

Table 1. Descriptions of the variables involved in this paper: socio-demographic drivers, knowledge scores, and the self-rated effectiveness of the school-based IEC materials.

Variables	Description	Mean	Min.	Max.
knowledgescore_pre	The percentage score of the IEC student participant during the pre-test	37.36%	0.00%	74.32%
knowledgescore_post	The percentage score of the IEC student participant during the post-test	51.34%	0.00%	95.95%
knowledgescore_ret	The percentage score of the IEC student participant during the retention test	47.02%	0.00%	89.19%
Age	The age of the IEC student participant in years	13	6	19
gender_male	A binary variable indicating 1 if the IEC student participant is male; 0, otherwise	0.4768	0	1
religion_roman catholic	A binary variable indicating 1 if the practiced belief system of the IEC student participant within his/her family is Roman Catholicism; 0, otherwise	0.4659	0	1
ethnicity_Filipno	A binary variable indicating 1 if the inborn racial culture of the IEC student participant is Filipino; 0, otherwise	0.6076	0	1
ethinicity_Mixed	A binary variable indicating 1 if the IEC student participant has mixed inborn racial culture other than Filipino (*e.g.* Filipino-Chinese, Filipino-American); 0, otherwise	0.2698	0	1
ethinicity_others [a]	A binary variable indicating 1 if the inborn racial culture of the IEC student participant is other than Filipino and mixed culture; 0, otherwise	0.1226	0	1
rabies vaccination history	A binary variable indicating 1 if the IEC student participant received a rabies vaccination previously; 0, otherwise	0.6178	0	1
HH_male	A binary variable indicating 1 if the gender of the person who makes the most income and performs the decision-making within the household of the IEC student participant is male; 0, otherwise	0.7221	0	1
HH_educ_college	A binary variable indicating 1 if the highest educational degree of the IEC student participant's household head is college; 0, otherwise	0.5777	0	1
HH_educ_postgrad	A binary variable indicating 1 if the highest educational degree of the IEC student participant's household head is at least a master's degree; 0, otherwise	0.3106	0	1
HH_educ_others [a]	A binary variable indicating 1 if the highest educational degree of the IEC student participant's household head did not finish a college degree; 0, otherwise	0.1117	0	1
H_income_1 [a]	A binary variable indicating 1 if the total monthly income of the household where the IEC student participant belongs is < PHP 25,000; 0, otherwise	0.1008	0	1
H_income_2	A binary variable indicating 1 if the total monthly income of the household where the IEC student participant belongs is PHP 25,000–49,999; 0, otherwise	0.2643	0	1
H_income_3	A binary variable indicating 1 if the total monthly income of the household where the IEC student participant belongs is PHP 50,000–74,999; 0, otherwise	0.2616	0	1
H_income_4	A binary variable indicating 1 if the total monthly income of the household where the IEC student participant belongs is PHP 75,000–99,999; 0, otherwise	0.1798	0	1

Variables	Description	Mean	Min.	Max.
H_income_5	A binary variable indicating 1 if the total monthly income of the household where the IEC student participant belongs is ≥ PHP 100,000; 0, otherwise	0.1934	0	1
H_dog_owership	A binary variable indicating 1 if the IEC student participant's household head has ≥ 1 dog; 0, otherwise	0.4605	0	1
iec_lecture	The self-rated effectiveness of the IEC lecture (0 = not effective; 1 = effective)	0.9071	0	1
iec_brochure	The self-rated effectiveness of the brochure self-rated IEC material (0 = not effective; 1 = effective)	0.8825	0	1
iec_video	The self-rated effectiveness of the video IEC material (0 = not effective; 1 = effective)	0.9344	0	1

[a]Reference category to avoid the dummy variable trap for panel regression analysis

To validate the results of the model estimation, model diagnostics were performed. the Breusch-Pagan Lagrange multiplier (LM) test was performed to test whether a panel estimation is preferred over a simple ordinary least squares estimation (Croissant and Milo 2008). The LM test null hypothesis assumes that there is no significant difference across units (*i.e.* no panel effect). Furthermore, the collinearity of the estimated model was also investigated here. This was performed by calculating the variance inflation factor (VIF) values of each knowledge score driver. A VIF greater than 10 implies degrading collinearity. Furthermore, robust standard errors were applied to address any form of heteroscedastocity (Kennedy 2008). Lastly, the residuals of Equation 2 can be assumed to follow a normal distribution since the sample size is equal to 1,101, which is a sufficiently large sample size ($n \geq 450$) (Hahn and Soyer 2005).

RESULTS

The Rabies Knowledge Scores

We plot the boxplots of the rabies knowledge scores for the pre-test, post-test, and retention test as presented in Figure 1 to see if there are apparent differences in the rabies knowledge scores on the three conducted tests. Figure 1 reports that the highest rabies knowledge score and highest mean rabies knowledge score were both observed during the post-test. Figure 1 shows that the standard deviations and coefficients of variations of the knowledge scores during the pre-test, post-test, and retention test as 16.12 and 43.15, 19.08 and 37.14, and 19.76 and 42.00%. To formally determine the significant differences, we performed statistical tests.

Differences in the Rabies Knowledge Scores

All the *p*-values of the normality tests of the scores from the pre-test, post-test, and retention tests were all $p < 0.01$ (Table 2). Friedman's test performed in this paper reports that the pre-test scores have a mean rank of 1.46, the post-test scores have a mean rank of 2.44, and the retention test scores have a mean rank of 2.10. The Friedman test also revealed a significant result ($p < 0.000$). Table 3 presents the Wilcoxon signed-rank test that was performed in detecting significant differences in the mean ranks of the rabies knowledge scores of the student participants. A significant difference was observed when: 1) post-test scores are compared to the pre-test score ($p < 0.0000$), 2) retention test scores are compared to the pre-test scores ($p < 0.0000$), and 3) retention test scores are compared to the pre-test scores ($p < 0.0000$).

Drivers of the Knowledge Scores

Table 4 reports the estimated parameter values of our panel regression model that hypothesizes that the knowledge score is driven by the student participant's socio-demographic drivers and self-rated effectiveness of IEC media. In terms of the student participant's socio-demographics, its age, and whether the student received a rabies vaccination before are significantly related to the knowledge score. Furthermore, the head of the household's gender and educational attainment also drive the knowledge score of the student participants. Finally, in terms of the school-based IEC program, the IEC lecture significantly drives the knowledge scores of the student. Furthermore, the calculated value of the mean-variance inflation factor of the model presented in Table 4 is 1.80. Lastly, the Breusch and Pagan Lagrangian multiplier test for random effects yielded a significant result ($p < 0.000$).

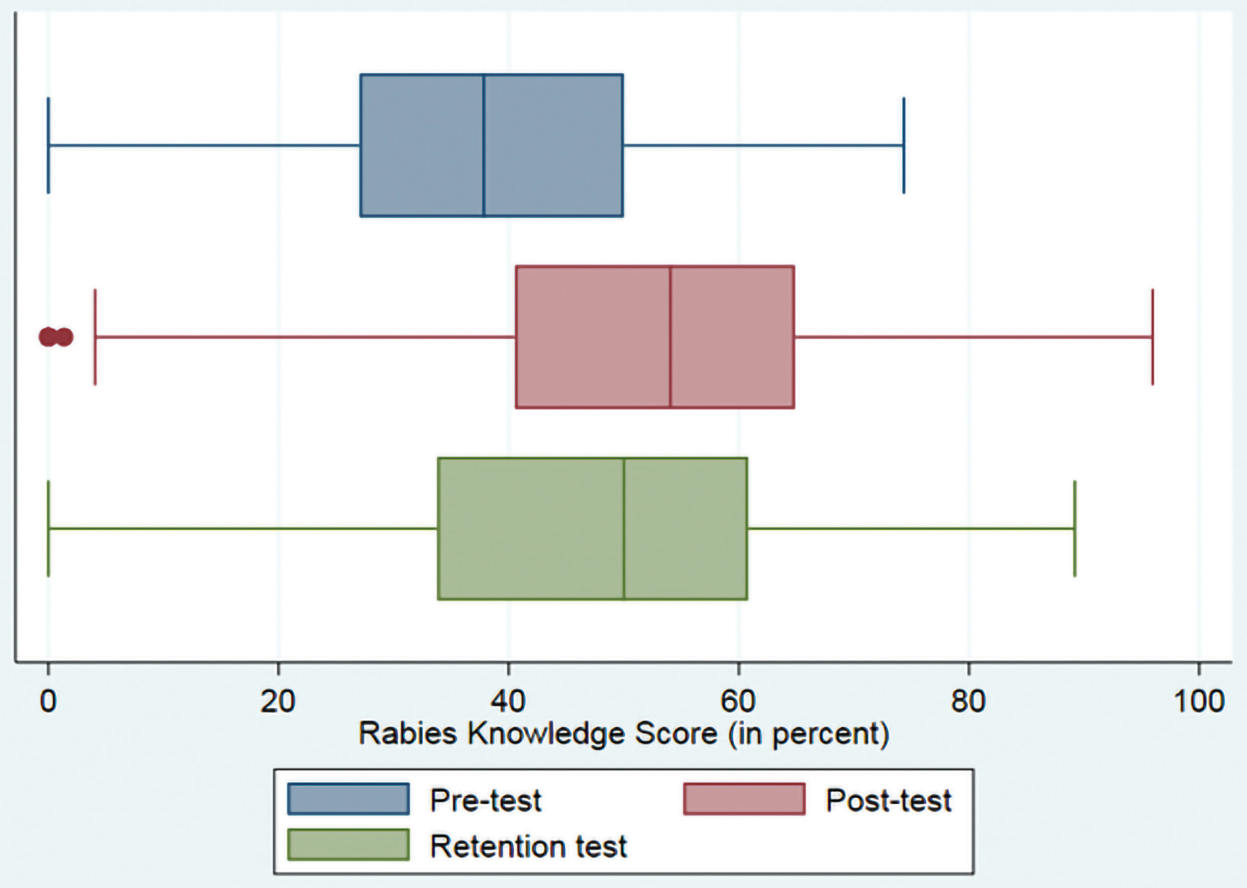

Figure 1. The boxplot of the rabies knowledge scores of the students (n = 367).

Table 2. Test for data normality using the Shapiro-Wilk test.

Statistical test	Computed test statistic	*p*-value[a]	Implication
Shapiro-Wilk test[b] (pre-test scores)	0.9882	$p < 0.01$	Normality assumption not satisfied
Shapiro-Wilk test (post-test scores)	0.9696	$p < 0.001$	Normality assumption not satisfied
Shapiro-Wilk test (retention test scores)	0.9769	$p < 0.001$	Normality assumption not satisfied

[a]Level of significance = 0.05
[b]Shapiro-Wilk test was used in assessing the normality of the scores because of its high statistical power (Yap and Sim 2011).

Table 3. Wilcoxon signed-rank test in detecting significant differences in the mean ranks of the student participant's rabies knowledge scores from their pre-test, post-test, and retention test.

Test comparison ($i - j$)		Negative ranks ($i < j$)	Positive ranks ($i > j$)	Ties ($i = j$)	*p*-values[a]
Post-test	Pre-test	66 (17.95%)[b]	294 (80.11%)	7 (1.91%)	$p < 0.0000$
Retention test	Pre-test	94 (25.61%)	264 (71.93%)	9 (2.45%)	$p < 0.0000$
Retention test	Post-test	213 (58.04%)	120 (32.70%)	34 (9.26%)	$p < 0.0000$

[a]Ho is rejected when *p*-value < 0.017 (*via* Bonferroni correction); Ho: *i*-test = *j*-test (*i.e.* insignificant difference)
[b]66/367 = 17.95%; all column total is 367

Table 4. Parameter estimates of the drivers of the rabies knowledge of student participants using random effects panel regression model[a].

Drivers	Parameter estimates	Robust std. err.	z	*p*-value [b]
Age	0.9043	0.2637	3.4300	0.0010*
gender_male	–0.8037	1.8222	-0.4400	0.6590
religion_romancatholic	1.3634	1.7580	0.7800	0.4380
ethnicity_Filipino	2.3048	2.4977	0.9200	0.3560
ethnicity_Mixed	3.9790	2.7535	1.4500	0.1480
rabies vaccination history	4.0498	2.2945	1.7600	0.0780*
HH_gender_male	3.5598	2.1547	1.6500	0.0990*
HH_educ_college	6.6520	3.2945	2.0200	0.0430**
HH_educ_postgrad	7.9939	3.5277	2.2700	0.0230**
H_income_2	2.8401	2.6660	1.0700	0.2870
H_income_3	–0.5553	2.7830	-0.2000	0.8420
H_income_4	2.0679	3.0535	0.6800	0.4980
H_income_5	2.9055	3.0750	0.9400	0.3450
H_dog_ownership	–0.8916	1.6629	-0.5400	0.5920
iec_brochure	–2.4800	2.3606	-1.0500	0.2930
iec_video	3.5492	2.8136	1.2600	0.2070
iec_lecture	9.9023	3.0959	3.2000	0.0010***
Intercept	11.9866	6.0425	1.9800	0.0470**
F-value	0.0000			
Wald chi2(17)	62.0100			

[a]Mean VIF = 1.80
[b]If significant: **p*-value ≤ 0.10 is significant at 10%, ** *p*-value ≤ 0.05 is significant at 5%, and *** *p*-value ≤ 0.01 is significant at 1%

DISCUSSION

School-based IEC Program and Knowledge Gain of Student Participants

Detecting observable change on certain indicators before and after an intervention is implemented signifies the impact of a program on a certain target population (Habicht *et al.* 1999). Based on the boxplots of the knowledge scores of the students, we conjectured that significant differences exist among the knowledge scores, *i.e.* at least one set of scores is significantly higher among others. To confirm that conjecture, we subject the scores to the Friedman test. The rabies knowledge scores of each student participant from the pre-test, post-test, and retention test were ranked from 1 (lowest) to 3 (highest) (Heumann and Schomaker 2016). The Friedman test result indicates that there exists a significant difference in the mean rank of the knowledge scores. This result confirms our earlier conjecture that there are apparent differences in the rabies knowledge scores on the three tests conducted. Furthermore, the *p*-values on the pairwise comparison of the scores from the three tests are all less than the level of significance *via* the Wilcoxon Signed-rank test, *i.e.* all the null hypotheses are rejected, implying that the differences in the mean rank score from each test are significantly different with each other.

It was evident that the knowledge scores of the students were significantly higher in the post-test than in the pre-test, which indicates the rabies knowledge gain among the student participants. This is consistent with the results of most of the KAP studies around Asian countries (Kanda *et al.* 2015; Kulkarni *et al.* 2016) and locally (Deray *et al.* 2018; Amparo *et al.* 2019). About 80% of the student participants had a post-test score higher than their pre-test scores (refer to Table 3). However, the retention test knowledge scores of the student participants were significantly lower than their post-test knowledge scores. Hence, it is not guaranteed that the existing IEC sessions constitute an effective learning strategy unless they are conducted in a more frequent manner. Note that the IEC program is usually done only once in every school as the CVO is the only institution primarily tasked to raise rabies awareness in the city. Repeating an IEC program on the same school might

happen after a year or two (*i.e.* when all the elementary and secondary high schools in Davao City have received at least one IEC program session) (Davao CVO; pers. comm. 23 Jan 2020). Consequently, more frequent IEC sessions can be costly, which poses a challenge for the local health agency. Nevertheless, there are several works of literatures that documented alternative approaches to reinforce rabies knowledge among students.

In China, repetitive reminders that were sent through a short messaging service *via* cell phone were found to be an effective way to increase the knowledge scores to rabies of the participants. A total of 10 messages were prepared and two messages every day were sent. This was done three times; thus, a total of 15-day information sessions using text messaging were conducted (Wu *et al.* 2016). On the other hand, a handful of local government units in the Philippines already incorporated rabies education in classroom instruction. In 2009, the rabies education that was integrated into the elementary curriculum was implemented in 962 public elementary schools (Lapiz et al 2012) in the province of Bohol. The successful implementation of the rabies education program in Bohol was replicated in El Nido, Palawan. The rabies curriculum manual – which was developed by a group of teachers, school heads, school nurses, and rural health unit midwives – was implemented in El Nido during the school year 2012–2013. Modules on rabies were integrated into Science and Health, Makabayan (such as in Civics, Social Studies, Geography, and History), Filipino, English, and Mathematics. However, one should take note that the first action taken to fully implement the integration of rabies and responsible pet ownership in the elementary school curriculum in El Nido, Palawan was passing a municipal resolution to the municipal mayor. Such action allowed municipal resources (*e.g.* funds and personnel staff) to be used in the implementation of the program (Deray *et al.* 2018). Consequently, the rabies manual that was developed in El Nido was adopted by the Global Alliance for Rabies Control in partnership with the Ilocos Norte Provincial Veterinary Office, Provincial Health Office, and the DepEd Divisions of Ilocos Norte, Batac City, and Laoag City and came up with the Ilocos Norte Rabies Prevention Program Manual on Grade School Curriculum Integration and Instruction Manual. Information about rabies, animal bite prevention, bite management, and responsible pet ownership was designed specifically for each grade level from Grades 1–6. The subject areas where this information can be integrated were similar to that in El Nido, Palawan (Amparo *et al.* 2019). Furthermore, rabies education was also integrated into extra co-curricular activities such as establishing rabies scouters, *i.e.* boy and girl scouts who successfully completed the rabies and responsible pet ownership training program (Lapiz *et al.* 2012).

Knowledge retention is an integral part of knowledge transfer. Retention is the ability to remember information/ concepts (Setiawati and Corebima 2017). Transfer, on the other hand, is the ability to remember information/ concepts and then their applications to a distinct situation (Narli 2011). For example, a person who remembers the symptoms of rabies infection is expected to take precautionary measures when having an encounter with a suspected rabid dog. If the acquired knowledge is retained, then knowledge transfer is possible (St. Clair 2004). Only 32.70% of the student scored higher in the retention test, while 9.26% maintained their scores from the post-test to the retention test. The majority (58.04%) of the student participants had a lower knowledge score in their retention test. Tables 1 and 3 displayed this trend: the mean post-test score being the highest (51.34%), followed by the mean retention test score (47.02%), then the mean pre-test score being the lowest (37.36%). This outcome is similar to Bailey *et al.* (2018) where the highest rabies knowledge scores are observed during the post-test, are lowest in the pre-test, and the scores on the retention test are between the two aforementioned scores. From this result, we ask: is the school-based IEC program the only reason why the overall knowledge scores in post-test and retention tests are generally higher than the pre-test scores? Understanding the drivers of the knowledge scores of rabies gives us additional insight into the effect of the school-based IEC program as well as the other factors (*e.g.* individual and household information) that are deemed useful in improving the existing school-based IEC program.

Regression Results

School-based IEC program media as drivers of knowledge score. The CVO has three IEC media: the brochure, the video, and the lecture. The campaign starts by distributing the brochures to the students, followed by a brief lecture, then playing the educational videos, and ends with a question-and-answer portion for the students. The brochures consisted of basic information regarding rabies and the proper practices against rabies, which are written in the Filipino language. On the other hand, the videos played show the students the appropriate ways to prevent acquiring the virus and the symptoms and behavior of rabies-infected patients when the post-exposure prophylaxis vaccine is not immediately administered. It is a 15-min video presentation. These brochures and educational videos were obtained from the DA and were revised by CVO accordingly (Davao CVO; pers. comm. 19 Mar 2021). Lastly, the lecture discusses the rabies situation in the city and the efforts of the local government to address rabies-related cases. The lecture, which is given by a CVO personnel, highlights how

the students can take care of their pet dogs, where they can ask for medical assistance for their pets, and how they can take care of themselves to prevent acquiring the rabies virus. By practice, about four to five parallel sessions are simultaneously conducted (1 session = 1 room) in a span of approximately 1 hr per session (Davao CVO n/d). The questions used to gather test scores were based on the questionnaire of Bailey *et al.* (2018) (Davao CVO; pers. comm. 08 May 2020).

Based on the regression results in Table 4, there is an increase in the rabies knowledge score by 9.9% when students rated the IEC lecture to be effective. The preference of learning methods and materials such as lectures is a common factor affecting the students' overall learning. A student's performance on a specific task/ assessment may be affected by the quality of teaching inside the classroom, greatly determined by the attitudes and approaches of educators during lectures (Okobia 2012). The effective IEC lecture conducted by the CVO contributed positively to the knowledge scores of the students as reflected by the coefficient estimate for the *iec_lecture* in Table 4.

The effective self-rating for the brochures and videos of the student participants were not significantly related to the knowledge scores. Crafting communication materials like brochures and videos have certain presentation concepts to be considered to become fully effective to the intended user. For instance, important text information such as headings and key points must be emphasized from the rest of the texts, leading to better retention (Kools *et al.* 2004). Moreover, limiting a video topic to at most 6 min through segmenting (Guo *et al.* 2014; Brame 2015), using of text and illustrations to specify information (de Koning *et al.* 2009), and using clear audio and appealing visuals (Mayer and Moreno 2003; Brame 2015) are deemed to be useful strategies to come up with effective videos. Furthermore, utilizing conversational communication is also an important factor in media instruction (*e.g.* brochure or video) as it allows students to become more engaged with the presented information (Meyer 2008). Additionally, existing works of literature such as those by Yiakoumetti (2007) and Tongpoon-Patanasorn (2011) agree that the use of local dialect for an individual's learning is advantageous. Tupas and Martin (2017) mentioned that delivering educational content using mother tongues is found to be effective for student learning. In fact, the Mother Tongue-based-Multilingual Education scheme has been implemented in the Philippines since 2012 (DepEd 2012). In addition, code-switching has been found to be a useful strategy in classroom interaction for clear discussion and ensuring the transfer of knowledge from teachers to students (Bista 2010).

Student participants' individual information. The student participant's age is a significant rabies knowledge score driver. Younger student participants belonging to this age group (below 15 yr) tend to exhibit a limited understanding and awareness level of rabies and related healthcare aspects (Tiwari *et al.* 2019). In this paper, it is expected that the rabies knowledge score will increase by 0.9043% as the age of student participants increases by 1 yr. de Abreu *et al.* (2010) contended that younger children tended to have weaker working memory; thus, over time, they forget the information they learned. Compared to adolescents, younger individuals are less conscious of their surroundings because their certain brain structures are not fully developed (Wierenga *et al.* 2014). In this paper, we expect that the knowledge score will be 3.17% lesser for a 6-yr-old student (youngest participant) as compared to a 19-yr-old student (oldest participant). Furthermore, the rabies knowledge score will increase by 4.05% if the student participant had previously received rabies vaccination. Receiving human rabies vaccination can be linked to exposure to rabid and potentially rabid dogs. According to Sambo *et al.* (2014), individuals who have previous exposure to rabid animals are 1.56 times more knowledgeable than those individuals who did not have rabies exposure.

Student participants' household information. We expect that the rabies knowledge will increase by 3.56% when student participants are living in a male-headed household. Males are perceived to have a critical role in contributing to an individual's cognitive and motor knowledge development (Lamb 2004). With male authority, the safety procedures taught at home are frequently being reiterated as males tend to be meticulous with instructing analytical aspects, such as imparting practical knowledge, during a child's preschool to early school years (Schwebel and Brezausek 2007).

Lastly, the educational attainment of the head of the household also drives the student participants' rabies knowledge score. The rabies knowledge score is expected to increase by 6.65% when the student participants have a head of household who finished college as compared to those student participants whose head of household did not earn a college degree (as the reference case). Furthermore, the rabies knowledge will also increase by 7.99% when the student participants have a head of household who have post-graduate education. Relatively higher educated household heads usually lead to a better foundation and attachment of children towards educational resources (*e.g.* books, media, educational conversations) that help build their understanding and knowledge on various topics such as health issues at home and school (Matsuyama *et al.* 2011).

CONCLUSION

This paper has provided insights into the implementation of the CVO's school-based IEC program in terms of rabies knowledge scores of the student participants. The majority of the student participants scored higher in their post-test than in their pre-test, suggesting a knowledge gain among student participants of the school-based IEC program. However, the majority of the students also tend to forget what they learned during the IEC program as their scores in the retention test (*i.e.* one month taken after the post-test) were lower than in the post-test. Thus, it is necessary for the CVO to find means to ensure that rabies knowledge is retained after the IEC sessions. The CVO can reinforce their IEC session by sending repetitive reminders to students (11–19 yr old) and to the parents of the younger students (5–10 yr old) through text messages. Additionally, CVO can lobby for the issuance of a local ordinance that aims to integrate rabies lessons in the subjects such as – but not limited to – Science and Health, Makabayan (Civics, Social Studies, Geography, and History), Filipino, English, and Mathematics. Furthermore, the CVO can also consider adopting the rabies manual developed in Bohol, El Nido, Palawan, or in Ilocos Norte. Capacity training in teaching rabies education can be considered by CVO to ensure the readiness of the school teachers. Furthermore, rabies education integrated into other school activities such as organizing a school-based World Rabies Day can also be an option of the CVO.

The identified knowledge drivers in this paper are as follows: 1) the age of student participants, 2) the student participant's rabies vaccination history, 3) the gender of the household head, and 4) the household head's educational attainment. Since it has been verified in this paper that rabies knowledge tends to be low for student participants, the CVO can consider, but not limited to, developing age-specific IEC media and incorporating the experiences shared by students who have rabies vaccination history as part of the content of the IEC material. In this way, the student participants can easily digest the learnings as they can relate with someone similar to their age. On the other hand, student participants raised by parents who have not attained college-level education tend to have low rabies knowledge scores. Thus, the IEC reinforcement through text messaging can be done more frequently on these student participants.

Meanwhile, it should be noted that the drivers considered in this paper were limited to the information gathered by the Davao CVO from the student participants from their school-based IEC program. This implies that the generalization of results from this study should be done carefully. Furthermore, only basic information was gathered from the student participants; thus, other potentially important information such as the duration of owning a dog and frequency of interaction between the dog and the student participant were not documented. These pieces of information can possibly serve as additional knowledge drivers. Lastly, it is recommended to include dialect in future studies, *e.g.* whether an individual's dialect can impede the potential benefit of the IEC media.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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