AQUADEMIA
2023, 7(1), ep23002
ISSN 2542-4874 (Online)
https://www.aquademia-journal.com/

Research Article

OPEN ACCESS

Knowledge and awareness on the fishery resources of elementary and high school students

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Citation: Mendoza Jr, A. B., Bernadas, M. B., Rances, A. B., Borejon, M. C., Tango, M. L. U., & Bradecina, R. G. (2023). Knowledge and awareness on the fishery resources of elementary and high school students. *Aquademia, 7*(1), ep23002. https://doi.org/10.30935/aquademia/13118

ARTICLE INFO

Received: 28 Dec. 2022

Accepted: 23 Mar. 2023

ABSTRACT

Knowledge and awareness on the natural resources among elementary and high school students are important attributes for future resource conservation and management. However, the enslaving features of gadgets and technologies has shifted the focus of the students away from nature-based knowledge and has motivated the government to integrate environmental education (EE) to the basic education programs. However, its implementation has not been successful due to lack of teaching materials and limits on teachers' capabilities. As such, it was found out that knowledge of elementary, junior high school (JHS) and senior high school (SHS) students on the native and unique natural resources of Bicol Region are almost the same, with an average score of 40%. But intervention through the use of EE teaching materials developed from the research publications and reports of Bicol University Tabaco Campus faculty-researchers showed that an increase of 31%, 21%, and 28% have been observed for elementary, JHS, and SHS students, respectively. However, a significant difference ($p<0.05$) was observed between high schoolers from urban setting as compared to the upland and island students with regards to the prior knowledge on natural resources, on the other hand, significant change was also observed in the increase of knowledge in upland (30% increase for JHS, and 42% for SHS) and island students (22% and 27% for JHS and SHS, respectively) as compared to the urban students (12% and 17% for JHS and SHS, respectively). No differences were observed for the elementary students across sites. Several factors were identified to influence knowledge and awareness of students such as, access to internet and mass media, exposure to local situations and prior knowledge, and influence of family and community.

Overall, knowledge and awareness of elementary and high school students on the local natural resources are relatively low but existence of local and relevant EE learning materials can help increase them. It is therefore, recommended that EE through the KADUNUNG program should be institutionalized to improve knowledge and awareness of students in Tabaco City.

Keywords: KADUNUNG, environmental education, DepEd Tabaco, learning materials

INTRODUCTION

Bicol region is endowed with rich fishery resources however are deteriorating and/or in critical condition (Mendoza et al., 2021a, 2021b; Soliman, 1994). The declining fishery resources can be attributed to many interlocking human induced factors basically as a result of population growth (Bush & Hirsch, 2005; Mendoza et al., 2021a, 2021b; Zhao et al., 2016). In most cases, level of awareness or knowledge about the resource is an important factor for the conservation and management of the resources (Lemke et al., 2010; Nura & Endris 2020; Wilkinson et al., 2006).

There are many sources of awareness and knowledge on environmental education (EE)–from family, community, and self (Fisman, 2015; Punzalan, 2020). However, most of the awareness and knowledge of the children are acquired in schools (Labrell et al., 2016).

It is believed that awareness and knowledge in environmental issues and concerns will be an answer to mitigate environmental problems (Filho & Palmer, 1992, as cited by Galang, 2010). However, evaluation by authorities on EE implementation is not stringently done (Carleton-Hug & Hug 2010) or in most cases like the Philippine setting are not well sustained (Galang, 2010).

One of the perceived hindrances by the implementers is the limit on environmental teaching materials. The department of education has few learning materials that are available for students and teachers on EE. Most of the materials are from global situation and seldom are from local condition (Marpa, 2020; Tan, 2004). Furthermore, limitation of teachers on the knowledge and awareness on EE adds up for its low integration in the curriculum (Abejuela et al., in press; Marpa, 2020). In the argument promoted by Boyd et al. (2009), teacher's preparation and training are vital in determining learners' achievement. This would imply that improved training of teachers and availability of teaching materials can result to good performance of students. Although study conducted by Rogayan and Nebrida (2019) have should that science students are highly environmentally literate, their ability to solve environmental problems are relatively low.

With the above premise, we consolidated all available research outputs of the faculty researchers from publications to reports and presentations and developed them into EE learning materials that can be integrated into K-12 subjects taking into consideration the most essential learning competencies.

Objectives

The main objective of this study is to determine the level of knowledge and awareness on the natural and native resources of the Bicol Region of the elementary and high students in selected schools in Tabaco City, Albay, Philippines.

Specifically, this would like to:

1. Compare the level of knowledge and awareness of selected upland, urban and island students on the natural and native resources of the Bicol Region.
2. Identify which among of the EE topics are the students well and least aware.
3. Determine the impact of developed learning materials on the level of knowledge and awareness among the selected elementary, junior high school (JHS) and senior high school (SHS) students in Tabaco City on the natural and native resources of the Bicol Region.

METHODOLOGY

Research Design

The study utilized a pre-/post-test design to identify the significant difference between the prior knowledge and gained learnings by the participants about the unique and natural resources of the Bicol Region.

Participants/Respondents

The study was participated by a total of 314 students in elementary and high schools in Tabaco City, Albay namely Bantayan (upland), San Lorenzo (urban), and San Miguel (island). Fifth grade in elementary, eighth grade in JHS, and eleventh grade in SHS with a general academic strand (GAS) were the chosen levels per area setting. Respondents in Bantayan comprised of 45 fifth grade and same number of 40 students in eighth grade and eleventh grade. In San Lorenzo, 33 pupils in elementary, 39 students in JHS, and 37 students in SHS participated while in San Miguel, 30 students in each level responded.

Instrument

To assess the prior knowledge of the students on 15 topics, the researchers prepared pre-test materials and were given beforehand and post-test materials were administered after the intervention to determine if the students have learned. Five items of multiple test questions were given to elementary level and 10 items of the same type of test questions are also given for JHS and SHS level. Researchers derived the test questions from the results of the study of Bicol University Tabaco Campus (BUTC) as well as from the materials of the resource speakers in radio programming and some were from the published articled.

Data Gathering Procedures

The researchers secured consent from the Schools Division Superintendent (SDS) of Tabaco City, school principals, and participants' parents to conduct the study. Upon approval, the distribution and retrieval of pre- and post-tests were done twice a week. Monday is scheduled for the distribution of pre-test materials for the next topic and the retrieval of post-test of the previous topic, while Friday is scheduled the other way around. The respondents were encouraged to listen during weekdays for one hour per day over the radio. A one topic discussion per week was designed so as not to add to the load of the regular academics of the students. For those who were not able to catch the live broadcast of the program, a replay can be watched in the KADUNUNG Facebook page. The researchers also gathered respondents' participation during the live broadcast discussion through question-and-answer segment of the program.

RESULTS AND DISCUSSION

Level of Knowledge and Awareness

Studies have suggested that although students have high interest in studying environmental and biological concepts and its dynamics, the level of understanding relative to these aspects are rather low (Ballantyne, 2004; Brody, 1996; Brody & Koch, 1990; Chapman & Sharma, 2001). Generally, EE in the Philippines is incorporated in science subjects based on the personal communication with teachers and this may have impact on the level of knowledge that may be acquired as the main focus of teaching is concept of the science topic and not the environmental concept *per se*.

Result of our study showed that elementary pupils in selected upland, island and urban schools in Tabaco City Schools Division have an average score of two out of five questions from 15 environmental and natural resources topics. On the other hand, junior and senior high students recorded an average score of around 3.5 out of 10 questions for upland and island schools, while the urban school registered about an average score of five. The findings basically reflect the fundamental knowledge and awareness of elementary and high-schoolers on the local and natural resources in the area. It suggests that the elementary level of environmental awareness is similar across different localities, and this would

mean that young pupils may have the same level of perception and understanding of the concepts of local and natural resources in the region and may be attributed to the standardized curriculum in primary education. Furthermore, at this stage, the education is more directed towards writing, reading and comprehension proficiencies. This can also be attributed to the basic idea that young learners are not generally motivated towards environmental and natural resources concerns and their inputs are mainly from their families and communities (Fisman, 2015; Punzalan, 2020). However, the situation is different for JHS and SHS students, where it appeared that students from upland and island areas have no significant differences ($p>0.05$) in the level of awareness and understanding pertaining to environmental and natural resources topics, however, is significantly different ($p<0.05$) from learners in the urban setting.

Results may suggest several ideas, first is that elementary pupils across different settings–the upland, urban and island, are generally trained and exposed to purely reading and comprehension and mathematics, and it may be concluded that their knowledge and awareness on environmental issues may come from the neighborhood, multimedia and social media. But for junior and senior high schoolers, situation may be different as there are some integrations in the lessons especially for biological sciences and they are exposed to several environmental activities initiated by the YES-O, the organization that is concerned with the implementation of environmental welfare activities in schools, and of course through multi and social media. One of the reasons why urban high schoolers have higher knowledge and awareness as compared to the island and upland high schoolers is the availability of social and multimedia. As observed, signals from telecommunications, radio and televisions are limited in island and upland areas as compared to urban zone. It is a recognized fact that these media outlets have an enormous impact to young adults, and students can acquire awareness and knowledge from these sources (Jena et al., 2015; Prandi et al., 2021).

KADUNUNG Environmental Education Topics

Several types of learning materials were developed from the more than 30 publications and research reports of BUTC faculty researchers. These were developed for elementary, JHS and SHS students be aware and knowledgeable of the natural gems of their own region. The materials developed discussed several aspects–from biology, ecology, population dynamics, taxonomy, and management setbacks and possibilities. These and some of the basic information of each resource, were organized in forms of flyers, posters, trivia booklets, and modules. The team had developed 10 main topics from among the more than 30 sub-topics identified. These topics can then be integrated in any of the learning competencies through several approaches especially through contextualization and localization. This can be a very good input to teaching and learning EE.

Topic 1. Gems of Bicol

This category includes the so-called Bicol Gems that pertains to the world's smallest and largest fish, known as Sinarapan and Butanding, which are abundant in the Bicol Region. Each IEC material included the biology of each species, specifically its characteristics, habitat, growth and reproduction, and diet or feeding. Each organism's taxonomic classification, as well as potential threats and conservation measures, were also indicated. Interesting facts and trivia were also entailed.

Topic 2. Fin fishes

Siganids, tuna, sardines, and eels, were among the species included for this category. As the name implies, this is a group of aquatic organisms that have the presence of fins. Biology and ecology, particularly anatomy, growth and reproduction, habitat and distribution, diet or feeding, and unique characteristics, were all covered for each species. Their taxonomic classification was also provided, as well as its various species that can be found in the Bicol Region. The fishing gears used to catch the species specifically for siganids and sardines were also listed in the materials.

Topic 3. Cultured species

This category highlighted the various species such as shrimps and prawns, marine crabs, tilapia, and milkfish, which are well-known for being processed in aquaculture or fish farming. Aside from the biology of each species, which covers its anatomy, growth and reproduction, habitat and distribution, diet or feeding, and distinctive characteristics, the IEC materials also included their taxonomic classification and various species found in Bicol. Since it is about cultured species, the different farming practices as well as the various species being cultivated were also indicated in the materials particularly in the posters.

Topic 4. Commercially important intertebrates

Commercially important invertebrates include freshwater snail, sea cucumber, sea urchin, and scallops. These are certainly economically valuable species that can be consumed by humans. The contents for the topic Scallops included taxonomic classification, biology, and ecology, which comprised its anatomy, reproduction, habitat, behavior, and diet. It also contained the scallop fishery and its various commercially important species in the Asid Gulf. For the other three invertebrates, only brief information on their biology, ecology, and taxonomy were provided in the posters and booklet.

Topic 5. Coastal habitats

This category focused on the different habitats that aquatic organisms can survive in namely corals, mangroves, seagrass, and seaweeds. The content for each topic comprises biology and ecology including types of reproduction, and habitat. Another is about the various forms and types of each species. The benefits, threats and conservation status were also provided in the materials.

Topic 6. Environmental issues

Harmful algal blooms (HABs), El Niño & La Niña, fish kill, and coral bleaching are all stated in the IEC materials as environmental issues that affect marine life. The definition, types, causes and effects, prevention, and trivia for each phenomenon were given emphasis on the materials.

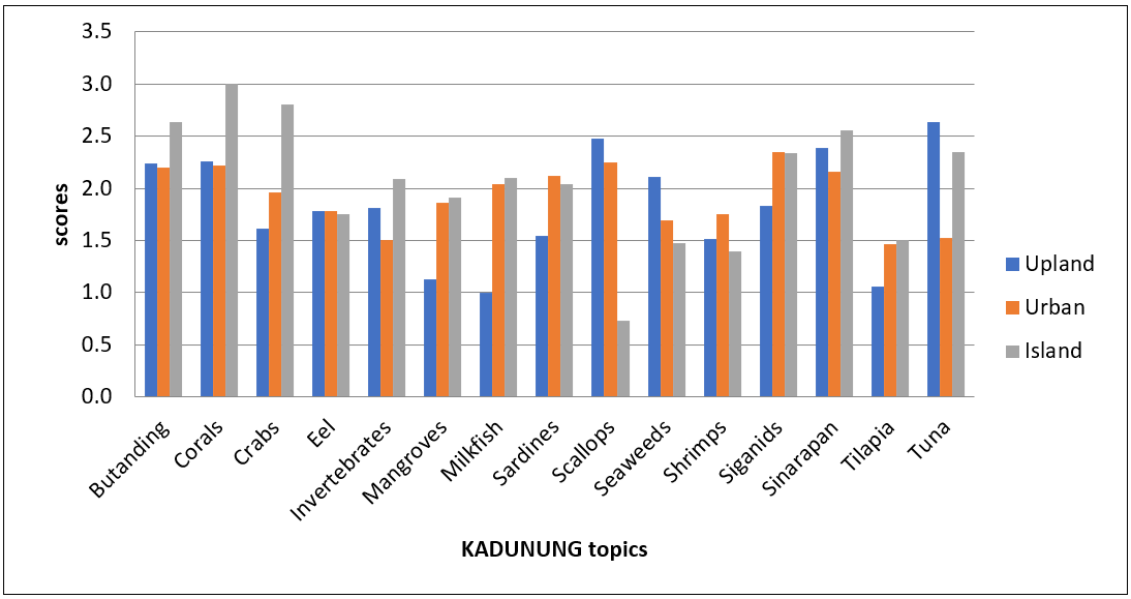

Figure 1. Comparison of pre-test scores among elementary students (Source: Authors)

Topic 7. Bodies of water

The Philippines' various water bodies, marine protected areas (MPAs), fisheries management areas (FMAs), Kuroshio Region, and Philippine Rise all fall into this category. The topic of water bodies focused on the classification of water bodies based on their beneficial uses, as well as the varied Bicol inland water bodies involved in research. For MPAs and FMAs, the establishment and its importance were indicated. Meanwhile, the contents for Kuroshio Region and Philippine Rise includes brief information about them and their origin.

Topic 8. Processing techniques and recipes

The various processing techniques available for some native and unique natural species of Bicol were also presented in the IEC materials. This includes fermentation of siganids (coyog; cooking, pickling, freezing, salting, and drying of sinarapan; canning, curing, and making katsuobushi of tuna; fermentation, drying, smoking, and canning of sardines; and different food preparation procedures for tilapia such as sinanglay, minced fish, marinated splited tilapia, splitted dried tilapia, fish skin chicharon, feremented tilapia, and fish meal tilapia.

Topic 9. Bicol products

The well-known tasty products of Bicol were also presented in the IEC materials. These products are Bicol express, pili nuts (crown jewels of bicol), sili ice-cream, pinangat, carmelado, dinailan, and pancit bato. The origin, ingredients and process on making these different Bicol products were enumerated in the materials.

Topic 10. Indigenous knowledge system

This category mainly focuses on the indigenous knowledge system of fishers on two species–scallops and siganids. The IKS for Siganids includes the various environmental cues used by fishers in predicting the abundance of juveniles as well as the events signal the low production of siganid juveniles.

On the other hand, ten indigenous knowledge in scallops were provided on the materials as a result of the long-term involvement of fishers in Asid Gulf in gleaning activities.

Interesting to note that although there seems to have no significant differences on the level of knowledge and awareness of elementary schoolers on the selected 15 topics, it can be noted that level of awareness is quite improved in island elementary pupils as compared to others (**Figure 1**).

More than half of the topics presented showed that island schoolers are more knowledgeable as compared to the counterparts in upland and urban areas. They are specifically aware on corals reefs, crabs, whale shark (butanding) and aquatic invertebrates and this can be attributed to the information being transferred from parents, friends and communities or in most cases these are the resources that the children in the island usually observed when they are in coastal areas or are playing along the beach (Chawla, 2008). On the other hand, scallops, seaweeds and shrimps are the remarkable topics where upland and urban pupils are most aware of as compared to island children and may be attributed media outlets–as these species are usually seen or are contents of advertisements. Notable also was the topics where all have higher awareness like butanding (whale shark), coral reefs, siganids and sinarapan–wherein these are very popular topic in the region as these are tourist attractions (Jena et al., 2015; Prandi et al., 2021). Sad to note only was that all elementary children have low awareness on one of the most popular fish in the area–tilapia–and it may be explained by the fact the children only knew that this is only utilized as food and very seldom they can hear or see a discussion on science of tilapia.

However, comparing the highs schoolers (junior and senior), level of awareness and knowledge on the 15 selected topics of students from upland area is significantly different from both upland and island locations. It appeared that for junior (**Figure 2**) and senior (**Figure 3**) students were more aware of almost all topics selected.

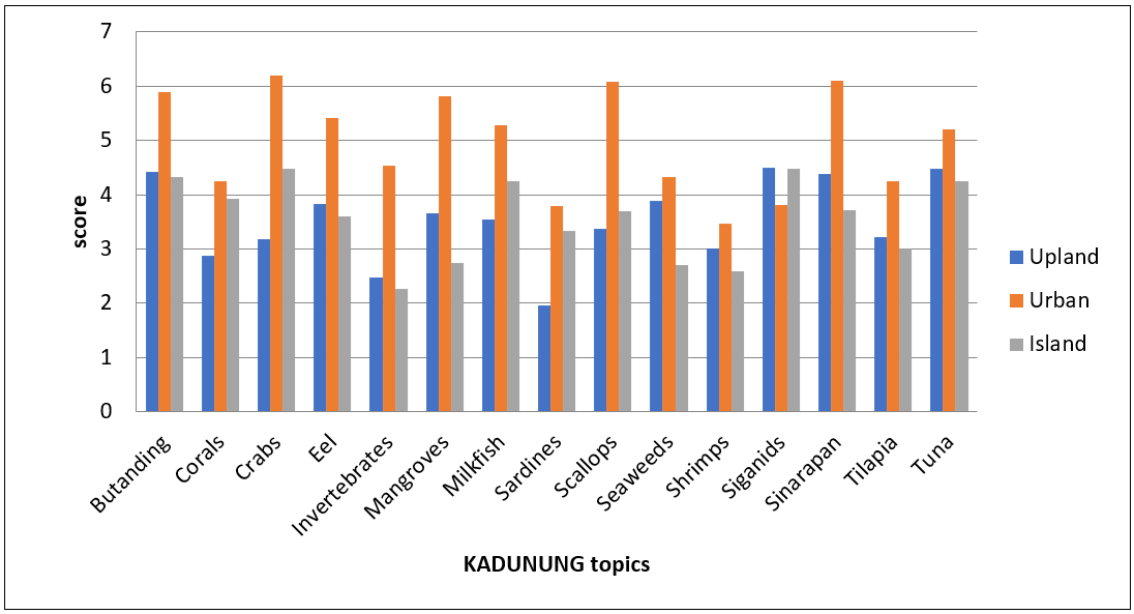

Figure 2. Comparison of pre-test scores among junior high school students (Source: Authors)

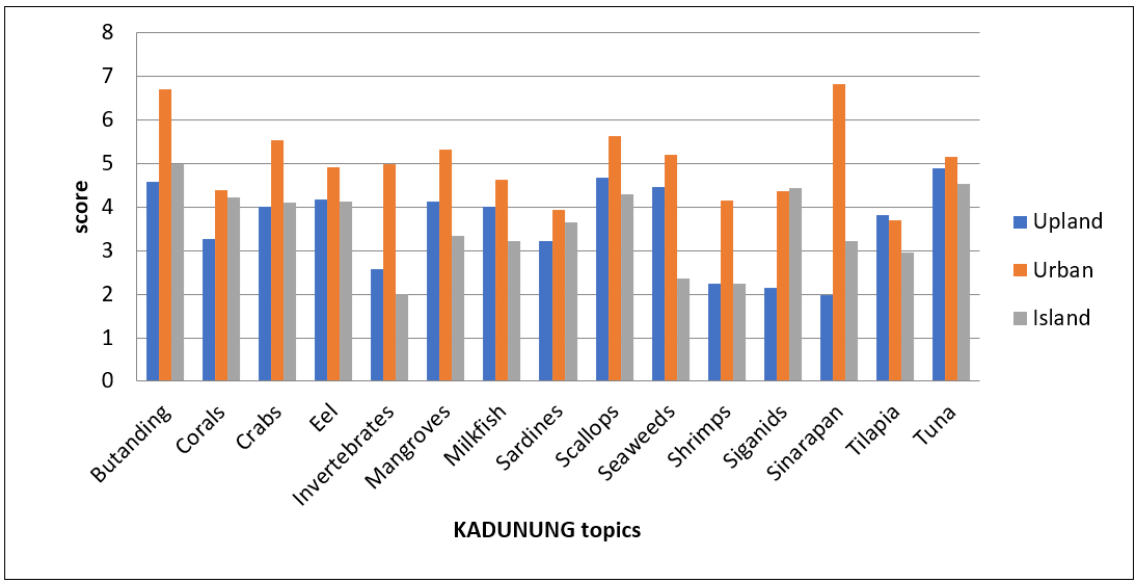

Figure 3. Comparison of pre-test scores among senior high school students (Source: Authors)

Remarkably, it was observed that topics that are popular either usually seen as topic in television reports and as content in multimedia or are usually displayed in markets and cooked.

Impact of KADUNUNG Learning Materials

With the radio-based learning program–KADUNUNG radio program, contents of the above-mentioned modules were discussed, at one module per week by an invited resource person, either the author of the published paper or a local expert. Result of the post-tests showed that the intervention program had a positive impact to the participants. Highest percent change in elementary level was recorded in urban participants with almost 40% increase followed by participants from upland then by participants from island with 29% and 25%, respectively. For JHS and SHS, highest change was attained by the students from upland with 30% and 42%, respectively, it was followed by students from island with 21% and 27%, respectively and the least was from urban school with 12% and 17%, respectively (**Table 1**).

Noticeable was the high percent change in elementary participants, and this can be attributed to the reality that, this time of pandemic, the parents and older siblings in the family are helping the younger ones in their school assessment tasks (Aliyyah et al., 2020; Eaton, 2020), and additional help from those of the urban participants where assignment tutors are utilized (Yusuf, 2021).

While for JHS and SHS, highest percentage change was recorded in upland schools with 30% and 43%, respectively, this was followed by island schools garnering 22% and 27%, respectively and the lowest was from urban schools with almost 12% and 17%, correspondingly. Factors that may have influenced the high percent change of the scores in posttests of upland and island schoolers are limited signal of internet and mass media and reduced mobility in upland and island at

nighttime, which means that these areas have fewer after school hour extra activities that makes them to have more time for studying and mainly to focus to their assessment tasks.

It is interesting to note that even during the pandemic, learning is possible, and our intervention had proven that even with short span of time devoted in this environmental awareness program it was relatively effective in increasing awareness and knowledge for our elementary and high school students.

As Chapman and Sharma (2001) elucidated,

> "Education fuels the three great engines of environmental knowledge: the environmental awareness that energizes the will for action; the environmental understanding that enables the formulation of action plans; and the environmental skill that supplies the means of achievement."

CONCLUSION AND RECOMMENDATION

The foregoing study revealed that students of elementary and high schools are less aware of the natural gems and resources of Bicol Region, but the level of awareness and knowledge observed was significantly different for high school students–with the urban schools exhibiting to have higher level of environmental awareness as compared to schools in upland and island zones and may be due to the influence of multimedia and mass media. However, no differences were observed for the elementary pupils across sites since education at this phase is more focused on reading and comprehension and mathematics. On the other hand, it showed that KADUNUNG radio-based learning had been an effective learning intervention to improve the level of awareness and knowledge of the students on the natural gem and resources of Bicol Region.

With this, it is recommended that continued EE program should be conducted to all schools to increase the level of awareness and knowledge of students on the natural gems and resources of Bicol Region. And this can be done by institutionalizing the integration of EE to the different learning areas. Furthermore, capacity training of teachers should be done regularly on the EE integration, alongside with the development and/or improvement of EE learning materials.

Author contributions: ABM Jr: wrote overall content of article; **MBB, ABR, & MCB:** conducted data collection, tabulation, & analysis; **MLUT:** conducted statistical analyses; & **RGB:** improved result & discussion portion. All authors agree with the results and conclusions.

Funding: This article was supported by Commission on Higher Education and Local Government of Tabaco.

Acknowledgements: The authors would like to thank Department of Education Tabaco City Division Office, collaborating schools, teachers, and students.

Declaration of interest: The authors declare that they have no competing interests.

Ethics declaration: Authors declared that ethical approval was not required for this study as it did not involve the use of sensitive or identifiable personal data and did not pose any risk to the participants. However, consent was secured from the Department of Education, Tabaco City Division in the distribution and collection of pre and post test instruments to elementary and high school students.

Availability of data and materials: All data generated or analyzed during this study are available for sharing when appropriate request is directed to corresponding author.

REFERENCES

Abejuela, G. A., Bobiles, R. U., Mendoza, A. B., Bernadas, M. B., Rances, Borejon, M. C., Tango, M. L. U., & Bradecina, R. G. (in press). *Environmental awareness, knowledge, and attitude of teachers in Tabaco City, Albay with emphasis to Bicol's natural resources*.

Aliyyah, R. R., Rachmadtullah, R., Samsudin, A., Syaodih, E., Nurtanto, M., & Tambunan, A. R. S. (2020). The perceptions of primary school teachers of online learning during the COVID-19 pandemic period: A case study in Indonesia. *Journal of Ethnic and Cultural Studies, 7*(2), 90-109. https://doi.org/10.29333/ejecs/388

Ballantyne, R. (2004). Young students' conceptions of the marine environment and their role in the development of aquaria exhibits. *GeoJournal, 60*(2), 159-163. https://doi.org/10.1023/B:GEJO.0000033579.19277.ff

Boyd, D. J., Grossman, P. L., Lankford, H., Loeb, S., & Wyckoff, J. (2009). Teacher preparation and student achievement. *Educational Evaluation and Policy Analysis, 31*(4), 416-440. https://doi.org/10.3102/0162373709353129

Brody, M. J. (1996). An assessment of 4th-, 8th-, and 11th-grade students' environmental science knowledge related to Oregon's marine resources. *The Journal of Environmental Education, 27*(3), 21-27. https://doi.org/10.1080/00958964.1996.9941463

Brody, M. J., & Koch, H. (1990). An assessment of 4th-, 8th-, and 11th-grade students' knowledge related to marine science and natural resource issues. *The Journal of Environmental Education, 21*(2), 16-26. https://doi.org/10.1080/00958964.1990.9941927

Bush, S. R., & Hirsch, P. (2005). Framing fishery decline. *Aquatic Resources, Culture and Development, 1*(2), 79-90.

Carleton-Hug, A., & Hug, J. W. (2010). Challenges and opportunities for evaluating environmental education programs. *Evaluation and Program Planning, 33*(2), 159-164. https://doi.org/10.1016/j.evalprogplan.2009.07.005

Chapman, D., & Sharma, K. (2001). Environmental attitudes and behavior of primary and secondary students in Asian cities: An overview strategy for implementing an eco-schools programme. *Environmentalist, 21*(4), 265-272. https://doi.org/10.1023/A:1012996016601

Chawla, L. (2008). Participation and the ecology of environmental awareness and action. In A. Reid, B. B. Jensen, J. Nikel, & V Simovska (Eds.), *Participation and learning* (pp. 98-110). Springer. https://doi.org/10.1007/978-1-4020-6416-6_6

Eaton, S. E. (2020). Academic integrity during COVID-19: Reflections from the University of Calgary. *International Studies in Educational Administration, 48*(1), 2020. 80-85.

Fisman, L. (2005). The effects of local learning on environmental awareness in children: An empirical investigation. *The Journal of Environmental Education, 36*(3), 39-50. https://doi.org/10.3200/joee.36.3.39-50

Galang A. P. (2010). Environmental education for sustainability in higher education institutions in the Philippines. *International Journal of Sustainability in Higher Education, 11*(2), 173-183. https://doi.org/10.1108/14676371011031892

Jena, A. K., Bhattacharjee, S., & Langthasa, P. (2015). Effects of multimedia on knowledge, understanding, skills, practice and confidence in environmental sustainability: A non-equivalent pre-test-post-test, quasi experimental design. *Journal of Educational Technology, 12*(3), 37-47. https://doi.org/10.26634/jet.12.3.3744

Labrell, F., Mikaeloff, Y., Perdry, H., & Dellatolas, G. (2016). Time knowledge acquisition in children aged 6 to 11 years and its relationship with numerical skills. *Journal of Experimental Child Psychology, 143*, 1-13. https://doi.org/10.1016/j.jecp.2015.10.005

Lemke, A. M., Lindenbaum, T. T., Perry, W. L., Herbert, M. E., Tear, T. H., & Herkert, J. R. (2010). Effects of outreach on the awareness and adoption of conservation practices by farmers in two agricultural watersheds of the Mackinaw River, Illinois. *Journal of Soil and Water Conservation, 65*(5), 304-315. https://doi.org/10.2489/jswc.65.5.304

Marpa, E. P. (2020). Navigating environmental education practices to promote environmental awareness and education. *International Journal on Studies in Education, 2*(1), 45-57. https://doi.org/10.46328/ijonse.8

Mendoza Jr, A. B., Borejon, M. C., & Bista, J. K. B. (2021a). Status of coral reefs in Lagonoy Gulf, Eastern Bicol, Philippines with emphasis on marine protected areas. *Asian Journal of Fisheries and Aquatic Research, 15(*6), 123-129. https://doi.org/10.9734/ajfar/2021/v15i630357

Mendoza Jr, A. B., Nieves, P. M., & Borejon, M. C. (2021b). Factors linking declining reef health ecosystem to poverty in Lagonoy Gulf, Eastern Bicol, Philippines. *Journal of Social Science Studies, 8*(2), 135-147. https://doi.org/10.5296/jsss.v8i2.18548

Nura, K. T., & Endris, F. S. (2020). Assessment of levels of community awareness to effects of forest degradation and their environmental management practices in Jimma Zone, South Western Ethiopia. *International Journal of Multicultural and Multireligious Understanding, 7*(2), 212-228. https://doi.org/10.18415/ijmmu.v7i2.1501

Prandi, C., Ceccarini, C., Nisi, V., & Salomoni, P. (2021). Designing interactive infographics to stimulate environmental awareness: An exploration with a university community. *Multimedia Tools and Applications, 80*(9), 12951-12968. https://doi.org/10.1007/s11042-020-09140-w

Punzalan, C. H. (2020). Evaluating the environmental awareness and practices of senior high school students: Basis for environmental education program. *Aquademia, 4*(1), ep20012. https://doi.org/10.29333/aquademia/8219

Rogayan, D., & Nebrida, E. E. E. D. (2019). Environmental awareness and practices of science students: Input for ecological management plan. *International Electronic Journal of Environmental Education, 9*(2), 106-119.

Soliman, V. S. (1994). Conservation and management of Lake Manapao (Philippines), a 'Sinarapan' (Mistichthys luzonensis) sanctuary: Status, problems and solutions. *Internationale Vereinigung für Theoretische und Angewandte Limnologie: Mitteilungen* [*International Association for Theoretical and Applied Limnology: Notices*]*, 24*(1), 279-283. https://doi.org/10.1080/05384680.1994.11904049

Tan, M. (2004). Nurturing scientific and technological literacy through environmental education. *Journal of International Cooperation in Education, 7*(1), 115-131.

Wilkinson, C., Caillaud, A., DeVantier, L., & South, R. (2006). Strategies to reverse the decline in valuable and diverse coral reefs, mangroves and fisheries: The bottom of the j-curve in Southeast Asia? *Ocean & Coastal Management, 49*(9-10), 764-778. https://doi.org/10.1016/j.ocecoaman.2006.06.014

Yusuf, N. (2021). The effect of online tutoring applications on student learning outcomes during the COVID-19 pandemic. *ITALIENISCH, 11*(2), 81-88.

Zhao, S., Lü, B., Li, R., Zhu, A., & Wu, C. (2016). A preliminary analysis of fishery resource exhaustion in the context of biodiversity decline. *Science China Earth Sciences, 59*(2), 223-235. https://doi.org/10.1007/s11430-015-5193-4