

Awareness and Perceptions of Bamboo as Sustainable Construction Material among Grade 12 STEM Students

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Abstract

Awareness among students regarding the benefits of bamboo in construction is crucial for promoting eco-friendly buildings and infrastructure. Bamboo offers several advantages over wood, including faster growth, greater sustainability, and easier shaping, as highlighted by Zen Ly (2014). This study aims to assess the awareness levels of Grade 12 STEM students on the benefits of using bamboo in construction, specifically in terms of it being a viable alternative to wood, a high-strength material, and a renewable resource. Using a purposive sampling method, fifty Grade 12 STEM-Engineering students participated in the survey. A 4-point Likert scale was employed to evaluate student perceptions of bamboo in construction, with options ranging from "strongly disagree" to "strongly agree." Quantitative data collected from the survey was analyzed by calculating the mean/average of the students' responses. The findings indicate that the students are generally aware of the benefits of bamboo as an alternative to wood, a high-strength material, and a renewable resource, with an overall mean score of 3.04. This score falls within the 3.25 to 2.51 range on the awareness scale, indicating moderate awareness. These results highlight the need to integrate bamboo-related information into the curriculum to further enhance student awareness and promote the use of sustainable materials like bamboo in the construction industry. Encouraging the adoption of bamboo can help foster environmentally responsible infrastructure and reduce reliance on traditional wood and other non-renewable resources.

Keywords: Bamboo in construction, Environmental sustainability, Student awareness, Renewable resource, High-strength materials

1. Introduction

Globally, deforestation has accelerated recently due to fast rising industrialization, urbanization, and population growth in which forest areas are being converted to cities. The evolution of bamboo has been seen as an alternative plant in reducing tropical deforestation in Ghana's forest. Stated in the study of Akwada and Akinlabi (2018), the development of bamboo resource as an alternative plant in the tropical forest will help reduce over-dependence on timber and other species which are almost depleting from the forest and will result in promoting a sustainable tropical forest in Ghana.

In 2013, the International Network for Bamboo and Rattan (INBAR) organized the Bamboo Construction for Inclusive and Green Development workshop, in which Dr. Juan Francisco Correal Daza presented a research suggesting that "bamboo panel products may be superior to equivalent wood products in terms of their physical and mechanical properties, as well as their seismic performance," (Newsroom Global, 2015).

In ShiQiao garden in Yangzhou, a city to the northwest of Shanghai, a bamboo courtyard teahouse by Chinese architects HWCD Associates has been very popular lately. The teahouse was made and organized in symmetric cubes that sit on a lake. "The tea house is known as the bamboo courtyard as it mainly uses bamboo to create an interesting play of vertical and horizontal lines," said the architect (Winston, 2014).

In the city of San Fernando, Philippines, the vital economic and ecologic uses of bamboo may yet be propelled and be reconsidered as the next alternative material for lumber in the country (Flora, 2019). In the statement made by the Secretary of the Department of Environment and Natural Resources (DENR), Roy Cimatu highlighted the promotion of the use of bamboo species as an alternative to lumber. Studies also show that bamboo prevents soil erosion and sequester carbon from the atmosphere (Flora, 2019).

Here in Misamis Occidental, Philippines, particularly at the restaurant located in Looc, Plaridel, a creative bamboo wall has been used in which it gives a pleasant and peaceful dine in experience for the customers (People of Oroqueita). Aside from using the bamboo in building infrastructures and being used in construction industry, the province of Misamis Occidental has taken one step forward towards becoming an ecological-friendly community as it started selling out reusable "bamboo straws," a green initiative seen to help the world in countering the worsening problem on plastic pollution (Molina, 2019).

Though many people are now aware of the use of bamboo in sustaining green life, awareness of the students still needs to be measured and analyzed. Related studies gathered by the researchers helped them to determine how much knowledge do students have on how sustainable a bamboo works in construction. The students' perception to what are the benefits of bamboo in constructions in terms of alternative wood, high-strength material and renewable resource was looked up to.

This study used or applied the non-experimental research design and was conducted using surveys and questionnaires online. The objective of this study was to identify the level of awareness of the students on why bamboo should be used as an alternative of woods and timber. The conceptual framework IV-DV was used in this study to further elaborate the study. The hypothesis in this study was that students were widely aware of the use of bamboo in construction. In addition, awareness of the grade 12 STEM engineering students of La Salle University – Ozamis City is a significant factor in determining bamboo's effectiveness and benefits. The mentioned hypothesis gave birth to this study which primarily aimed to provide awareness to all individuals not just students but to all people in society on the benefits of using bamboo in construction.

2. Significance of the Study

This study was conducted to have an attempt to contribute further knowledge that can be helpful in the fields of Environmental Sciences or any situation possible. By far, there were no studies that dealt with determining of level of awareness among the Grade 12 – STEM students and so the beneficiaries of this study are:

- Students

Students would be benefited to this study as they are the main respondents in which their awareness would be determined. This study would provide them enough knowledge and help them understand why we need to switch to use bamboo in building infrastructures rather than using woods because of its benefits not just in saving the environment but also to them (Galmarini et.al., 2022)

- Engineers and Architects

This study would help enlighten engineers and architects to the capacity of the use of bamboo in construction and would help them realize its advantages and benefits. Thus, this would make their future projects more environmental-friendly and be able to promote the use of bamboo (Brendenoord, 2024)

- General Public

The general public would be more eco-aware and eco-conscious to protect the environment by just stopping cutting down trees and switch to an alternative wood which is bamboo that can really help not just the people for their basic necessities but also to the environment. As for the bamboo farmers, they could earn money for selling bamboos and help them make a living (Li et.al., 2025).

- Future Researchers

This study would be a basis for future researchers who were also interested in the same scientific venture. Future researchers would be benefited in this study as it contains information regarding the use and benefits of bamboo which they would be interested to venture in the future.

- The nature and the environment

One of the focuses of this study was to help restore and save the environment. The cutting of trees or the deforestation in some forest areas is one of the crises people faced because they now experienced too much heat caused by global warming. The greenhouse gases are being increased in levels of carbon dioxide, chlorofluorocarbons and other gases in the air that many of them released by human activities. In some way, this research study would spread awareness to all the people to stop cutting trees for industrial use. Stop converting forests into a commercial area. In construction, instead of using wood, it is preferable to use bamboo because it is a fast-growing tree/grass. It could be harvested and could be used after 5 years of planting it. Planting lots of bamboo could help limit the amount of carbon dioxide in the atmosphere and it enhances the oxygen that we breathe (Kabir et.al., 2023)

3. Methodology

Senior high school students taking STEM have been chosen to be the participants of the study. The goal of this study is to assess the college student's knowledge, attitudes, perceptions and level of awareness on the use of herbal plants as medicine which is found in their community particularly in Iligan City, Lanao del Norte.

3.1 Participants

The participants of this study were fifty (50) Grade 12-STEM students from La Salle University. No exact numbers of participants in each section, thus, in all 8-sections of the STEM strand, a total of fifty students were taking an engineering course were the respondents. Purposive sampling technique was used in order to select the respondents. The researcher of this study obtained permission and consent from the students for

voluntary participation. The participants are aware that they can withdraw their participation from the study anytime. In addition, the confidentiality of their responses was also emphasized in the consent form prior to participation.

3.2 Research Method

To determine the level of awareness among Grade 12-STEM students on the benefits of using bamboo in construction, the study will utilize a descriptive survey approach. This approach is appropriate to assess students' awareness, perception, and knowledge of bamboo as a sustainable construction material. Furthermore, this method aims to identify the benefits of bamboo most recognized by the respondents and their attitude toward its application in the field of construction. The primary instrument for data collection will be a researcher-made questionnaire. This questionnaire will be divided into five parts: Part 1 will gather the demographic profile of the respondents; Part 2 will assess their general knowledge of bamboo as a construction material; Part 3 will measure their awareness of the environmental and economic benefits of bamboo; Part 4 will examine their perceptions regarding its practicality and durability; and Part 5 will determine their exposure to and preference for bamboo in construction practices. The collected data will be analyzed using statistical tools such as frequency, percentage, average weighted mean, ranking, and rating scale.

3.3 Distribution of Questions and Research Instruments

In this study, a structured questionnaire will be used to gather the necessary data. The instrument will be designed by the researchers and validated through consultation with research advisers. To ensure relevance, the structure and flow of the questionnaire will be partially based on the format used in previous studies such as that of Hadji Abas and Salic (2016), who examined the knowledge and attitudes of Meranao students regarding indigenous herbal plants. Likewise, the perception and awareness components of the questionnaire will follow the format used in Zaidi et al.'s (2022) cross-sectional study on public awareness and practices towards herbal medicines in Western Saudi Arabia, adapted to the context of bamboo as a construction material. These references will help ensure the content validity of the instrument. The final questionnaire will be administered via an online platform due to ongoing pandemic considerations.

3.4 Sampling Technique

The study will employ a purposive sampling technique to select the respondents. This non-probability sampling method is appropriate as it allows the researchers to intentionally choose individuals who are most relevant to the objectives of the study. In this case, the participants will be fifty (50) Grade 12 students under the STEM strand from La Salle University-Lyceum, Ozamiz City, who are inclined toward engineering and construction-related courses. The selection assumes that these students possess basic knowledge and potential future engagement in the construction industry, making them suitable for assessing the level of awareness regarding the use of bamboo as a construction material.

3.5 Data Gathering Procedure

To acquire the information needed in the study, the researchers carried out the following procedures:

a. Preliminary Procedures

The researchers brainstormed and planned well the possible statements and situations included in the survey questionnaire that the respondents answered. Upon the preparation of the questionnaires, the researchers asked approval to their research adviser and capstone teacher if the survey questionnaire was relevant and appropriate before the

gathering of data. The researchers then proceeded to data gathering when the survey-questionnaire was approved.

b. Gathering of Data

After the survey-questionnaire approval, the researchers started to gather data. In gathering the data, the researchers asked consent from the respondents, and if given permission, the researchers then administered the researcher-made online questionnaire to the students. In the online survey-questionnaire, open-minded statements/situations were used and the information collected using this method include the perception of the students based on their awareness of the benefits of using bamboo in construction using the 4-pt Likert-Type Scale.

c. Treatment of the Data

The data gathered during the online survey were analyzed and interpreted using statistical methods like the Central Tendency of a distribution to determine the mean. Interpreted data were then presented through tables and a graph to further understand well the results. Thus, the use of the table and graph was to visually show the results between different data sets to emphasize the nature of a particular aspect of the data.

d. Ethical Considerations

All procedures done by the researchers followed ethical considerations such that informed consent, voluntary participation, confidentiality, anonymity, and only assessing relevant components based on research purposes. Upon following the ethical considerations, researchers ensured the safety of the information and data gathered from the respondents. The researchers ensured that the respondents were fully informed about the evaluation being conducted and free from coercion. Researchers took account that any identifying information was not made available to or accessed by anyone but only the conductor of the study and respect confidentiality. And lastly, researcher assessed only those components that were relevant to their conducted study.

3.6 Data analysis

This chapter presents, analyzes, and interprets the data obtained from 50 Grade 12-STEM Engineering students in La Salle University – Integrated School, Ozamis City. The researchers provided 9 statements about bamboo which were divided into 3 categories: a. bamboo as an alternative wood; b. bamboo as a high strength material, and; c. bamboo as a renewable resource.

In each category, there are 150 total responses or total numbers of values in the set. Thus, it was used in finding the mean of the data in each category. The mean (average) of a data set was found by adding all numbers in the data set and then dividing by the number of values in the set. The data sets of this study were 1, 2, 3, and 4 in which these were the numerical indicators used to determine the level of awareness of the students.

Table 1: Level of Awareness Scale and Indicator

Scale	Indicators
4.00 – 3.26	Highly Aware on the Benefits of Bamboo (<i>Extremely Aware</i>)
3.25 – 2.51	Highly Moderately Aware on the Benefits of Bamboo (<i>Aware</i>)
2.50 – 1.76	Moderately Aware on the Benefits of Bamboo (<i>Unaware</i>)
1.75 – 1.00	Low Awareness on the Benefits of Bamboo (<i>Extremely Unaware</i>)

The table above was used to determine the level of awareness among Grade 12-STEM students on the benefits of using bamboo in construction. The scale served as the basis to determine their awareness based on the mean (average) on the data set.

4. Results and Discussion

Grade 12-STEM students showed an overall “Aware” level of understanding about bamboo’s construction benefits (mean 3.04). Awareness was highest for bamboo’s high-strength properties (mean 3.10; top item 3.54, Extremely Aware), while awareness for its roles as an alternative wood and renewable resource was solid but equal (both 3.01), with relatively lower understanding of CO₂ mitigation (2.92) and reharvesting (2.80). Educational efforts should deepen knowledge of environmental mechanisms and sustainable management, building on strong recognition of bamboo’s performance and versatility.

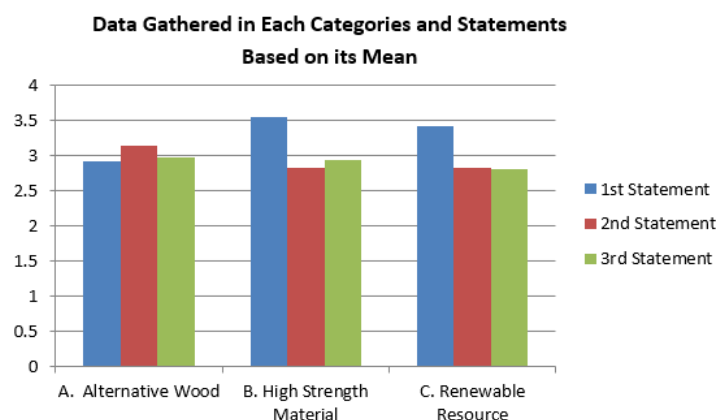


Figure 1. Data Gathered in Each Categories and Statements Based on its Mean

The figure above presents the mean awareness score for each survey statement. The tallest bar indicates the highest mean score, while the shortest bar indicates the lowest. This graph serves as a reference to aid interpretation of the results.

Table 2: A. Bamboo as an Alternative Wood

Statement	Mean	Q.D.
1. Bamboo as an alternative wood in the tropical forest will help limit the amount of carbon dioxide (CO ₂).	2.92	Aware
2. Bamboo developed as a valuable and superior alternative for wood composite manufactured, such as plywood, and fiberboard.	3.14	Aware
3. Bamboo has potentially become an ideal replacement in areas where steel cannot easily be produced.	2.98	Aware
Total	3.01	Aware

To check if the students were really aware or unaware of the benefits of using bamboo as an alternative wood, the researchers solved for its meaning in each statement. Later, the meanings in each statement were added together to determine the results of their level of awareness of bamboo as an alternative wood in general based on the scale and indicators in table 1.

All the statements under this category show that the respondents were aware to each of the statements given. Thus, among the three statements, statement number 2 had the greatest mean of 3.14 in which more students answered that they were aware that bamboo developed as a valuable and superior alternative for wood composite manufactured, such as plywood, and fibreboard. In this case, they knew already that a bamboo can also be used

as an alternative to plywood thus most of the houses we can see everywhere uses this. The smallest number of mean that has 2.92 was the first statement where the students were still aware that a bamboo as an alternative wood in the tropical forest will help limit the amount of carbon dioxide (CO₂).

Therefore, the level of awareness among Grade 12-STEM students on the benefits of using bamboo in construction in terms of alternative wood was highly moderately aware or in laymann's term, they were aware because the total mean was 3.01 which fall between the scales of 2.51 - 3.25.

Table 3: B. Bamboo as a High Strength Material

Statement	Mean	Q.D.
1. Bamboo as an alternative wood in the tropical forest will help limit the amount of carbon dioxide (CO ₂).	3.54	Extremely Aware
2. Bamboo developed as a valuable and superior alternative for wood composite manufactured, such as plywood, and fiberboard.	2.82	Aware
3. Bamboo has potentially become an ideal replacement in areas where steel cannot easily be produced.	2.394	Aware
Total	3.10	Aware

In the second category where statements under bamboo as a high strength material belong, the largest number of mean was the first statement that had 3.54 as an average. The respondents were extremely aware that bamboo was known as a high-strength material, renewable resource and was cheaper than steel because most of them knew already that a bamboo is way cheaper compared to steel and that it was a renewable resource for a reason that they bought and used bamboo before. The second statement where bamboo had been seen had a higher compressive strength than wood, brick, and concrete had the smallest mean which only had 2.82. Though it had the least mean, the respondents were aware that a bamboo had a higher compressive strength than wood, brick, and concrete in a way that they might have used or seen bamboo before and was able to compare it to the other high-strength materials.

To check if students were aware or unaware that a bamboo had a characteristic that it was a high strength material in general, the researchers solved for its total mean where they added all those mean from each statement. The results show that the mean of the second data set was 3.10 in which it lies between the scales of 2.51 – 3.25. Therefore, the level of awareness among Grade 12-STEM students on the benefits of using bamboo in construction in terms of its high strength material was highly moderately aware or that they were aware.

Table 4: C. Bamboo as a Renewable Resource

Statement	Mean	Q.D.
1. Bamboo as an alternative wood in the tropical forest will help limit the amount of carbon dioxide (CO ₂).	3.42	Extremely Aware
2. Bamboo developed as a valuable and superior alternative for wood composite manufactured, such as plywood, and fiberboard.	2.82	Aware
3. Bamboo has potentially become an ideal replacement in areas where steel cannot easily be produced.	2.80	Aware
Total	3.01	Aware

In the third and last category where bamboo had been described that it is a renewable resource, the students were extremely aware that bamboos are renewable materials and extremely versatile resources with multipurpose usage which had the largest mean of 3.42 among the three statements. Students knew that a bamboo could be used in many other things not just in constructions but also in furnitures, musical instruments, straws, spoons and forks, water pipes, and even food. Having said that the respondents were extremely aware of this characteristic of a bamboo, indeed they have known already since then that a bamboo is a renewable resource and has a multipurpose usage. On the other hand, the respondents were aware that a bamboo can be re-harvested every three years without any harmful effects on the environment which also had the smallest number of mean among the three statements. Though this statement had the smallest mean of 2.80, the respondents were still aware that a bamboo can be re-harvested in small period of time unlike the other wood crops.

All the mean from each statement were added together to get the total mean. The total mean was 3.02. Therefore, the level of awareness among Grade 12-STEM students on the benefits of using bamboo in construction in terms of a renewable resource in general was highly moderately aware with a mean of 3.01 that falls between the scales of 2.51 - 3.25. In laymann's term, the students were aware that a bamboo is a renewable resource.

Table 5: Summary of Results According to its Mean

Benefits	Mean	Q.D.
A. Alternative wood	3.01	Aware
B. High strength material	3.10	Aware
C. Renewable Resource	3.01	Aware
Total mean	3.04	Aware

5. Conclusion

In conclusion, the researchers found out that students were aware of the benefits of using bamboo in construction in terms of alternative wood, high-strength material, and renewable resource as it had an overall average of 3.04 that falls under the scales of 3.25 – 2.51. Among the listed 3 categories of benefits of bamboo, bamboo as a high strength material has been seen that most of the students were aware of it based on the results in finding its average with a value of 3.10. Contrarily, the benefits of using bamboo in construction in terms of alternative wood and a renewable resource had the same average based on the data gathered. Thus, this means there were no listed benefits that the respondents were least aware of. (Refer to table 5).

After all is said and done, there was no problem at all thus, most of the respondents or the students were highly moderately aware of the benefits of using bamboo in construction. But for those students who were not aware of it, to address the problem that some students/youths were still not aware of it, a research project like having an advocacy symposiums or seminars would be a good idea where they will be taught by us or by other environmental organizations about all the benefits of using bamboo. Also, providing them enough knowledge not just only about the benefits of bamboo, but also on how to protect our environment would be in most need so that they will become environmentally-aware and eco-conscious where promoting a green life is at utmost priority.

The results showed that most students from the 50 random respondents who participated in the survey in the purposive sampling were highly moderately aware of the benefits of using bamboo in construction. This was to conclude that Grade 12-STEM students were aware and had enough knowledge of what bamboos could've to provide not just a plant that reduces carbon dioxide in the atmosphere but as an alternative wood or material to have been used in building constructions like houses, buildings, drainage, and earthwork constructions.

Additionally, the following conclusions were based on important findings:

1. Students were aware of the benefits of using bamboo in construction in terms of alternative wood, high-strength material, and renewable resource as it had an overall average of 3.04 that falls under the scales of 3.25 – 2.51.

2. Among the listed 3 categories of benefits of bamboo, bamboo as a high-strength material had been seen that most of the students were aware of it based on the results that had an average of 3.10.

3. To address the problem that some of the students were not aware of some of the benefits of bamboo, a research project like an advocacy symposium will help them be enlightened.

Recommendations

After a thorough analysis of data, the following recommendations have been made:

1. That those students who are aware and do not have enough knowledge on the benefits of using bamboo should have enough knowledge about I and thus, it is recommended that they should attend symposiums or seminars regarding bamboo and/or other environmental discussions;

2. That the future researchers should conduct a study similar to this paper but should provide more benefits of bamboo when used in construction just like the cost or expenses, availability, and etc.;

3. That the future researchers should conduct a survey not limited to STEM-Engineering students but to all senior high school students or Grade 12 students to measure their awareness on the benefits of using bamboo so that they can determine if most youths nowadays are environmentally aware of it or not; and

4. That the future researchers should conduct a survey to the construction workers, architects, and civil engineers to measure their level of awareness on the benefits of using bamboo in construction because they are the ones who plan, design, and build establishments

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