Eco. Env. & Cons. 28 (February Suppl. Issue) : 2022; pp. (S28-S34)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2022.v28i02s.005

Lecturers' Perception of Green Building Technology: Implications to Sustainable Construction and Environmental Education in Anambra State, Nigeria

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(Received 28 June, 2021; Accepted 17 July, 2021)

ABSTRACT

Green building technology (GBT) implies products of environmental sciences and technology infusion integrated in constructions to achieve an end product of green or sustainable building. This study examined Lecturers' perception of GBT as a driver for the teaching and learning of sustainable construction and environmental education in Anambra state, Nigeria. Structured questionnaire survey of 64 lecturers teaching constructions and environmental science inclined courses provided the data for the analysis. Findings revealed that active players for environmental transformation are required in the areas of engineering, technology, environmental science, architecture, and education. Also, although 100% of the respondents were aware of sustainable development goals, 92.2% need more orientation on GBT required to achieve sustainability in construction industry. The respondents have interest in GBT (89.1%), but actions such as reading researches (37.5%) and publishing in GBT (23.4) were very low. The implication of the findings indicates that poor attention to sustainable constructions and environmental education in Anambra state is proportional to the perception of higher institution lecturers towards GBT.

Key words: *Lecturers, Perception, Green building technology, Sustainable construction, Environmental education*

Introduction

Education ensures that individuals acquire knowledge, skills and attitudes necessary for coping with real life issues (Organization for Economic Cooperation and Development - OECD, 2003). When opportunities are provided to gain knowledge and skills that can be used to defend, protect, conserve, or restore the environment, one is said to engage in environmental education (Monroe *et al.,* 2007). According to EPA (2018) "environmental education is a process that allows individuals to explore environmental issues, engage in problem solving, and take action to improve the environment." Exploring environmental issues fosters awareness and sensitivity, enhances knowledge and understanding, leads to attitude adjustment, skill acquisition, and participation in tackling challenges of the environment (Monroe *et al.,* 2007; EPA, 2018). Education about the environment helps communicate the expected environmental behaviours and provides the strategies towards solving environmental crises (Monroe *et al.,* 2007).

The environment is degraded by many factors:

climate change, pollution, excessive extractions, and waste disposals, among others. But one dreadful source of environmental degradation issues is the construction industry. Literature acknowledges that conventional constructions consume as much as 40% of all resources and generate 30-40% of harmful waste, thus it is called '40% constructions' (Dahiru *et al.,* 2014). Consequently, green building knowledge development, environmental preservation, resource sustainability, and ecology integration in designs and construction are given attention in research both in developed and developing countries (Darko and Chan, 2018; Ogunsote *et al.,* 2016; Ajibola, 2015; Nwokoro and Onukwube, 2011).

In tackling the worrisome environmental degradations caused by construction activities, sustainable construction emerged, and is based on the principles of: reducing consumption, reusing and recycling resources, protecting nature, eliminating toxics, applying life-cycle costing, and using quality (Kibert, 2013). Engaging sustainable construction principles produces Green Building (GB). GB in its design, site, construction, operation, maintenance and deconstruction seeks climate change redress, environmental enhancement, waste reduction, energy efficiency, renewable sources integration, improved occupants' health and performance (Chukwu *et al.,* 2019; Kibert, 2013). However, Green Building Technology (GBT) is vital in actualizing GB (Darko and Chan, 2018).

GBT refers to equipment, products and systems made from the infusion of environmental science and variant technology (Show, 2010). These technologies are integrated in building design and construction to achieve an end product of a green or sustainable building (Ahmad *et al.,* 2016). GBT includes technologies with respect to energy-efficient heating, ventilation, and air conditioning (HVAC) system, water efficient and recycling technologies, high performance window glazing, light pipes, renewable energy reliant integrations which ensure that buildings conform to the sustainable principles (Darko and Chan, 2018; Sadineni *et al.,* 2011; Monu and Neelam, 2015; Omrany *et al.,* 2016). GBT therefore helps to minimize the degradation of the environment, achieve zero or low greenhouse gas (GHG) such as carbon dioxide emission, conserve the use of energy and natural resources, promote the use of renewable resources, and improve health and environment for all forms of life (Monu and Neelam, 2015).

Notwithstanding the benefits of GBT, there is serious lag in its adoption, especially in developing countries. Studies have shown that there are perceived barriers to the adoption of GBT (Ahn *et al.,* 2013; Chan *et al.,* 2016). The detached interest of developing countries in adopting GBT in constructions has been attributed to lack of awareness, limited knowledge of the stakeholders, unfamiliarity of products and advantages, persistent use of traditional technologies, and lack of GBT education and training (Darko and Chan, 2018). In Anambra state, Nigeria, environmental education and sustainable construction are needed to rewrite the wrongs of natural and anthropogenic activities with effects in high temperatures, dust storms, excessive aridity, flooding, soil and gully erosion, landslides, pollution and contamination, desertification etc. (Egboka and Okoyeh, 2019).

There is no education and training without teachers, instructors, and lecturers as the case may be. At the higher education level, lecturers are the persons providing information and guidance to learners for acceptable decision making. Although lecturers' contact with the learners may not lead to change in behaviour (Monroe *et al.,* 2007), the perception of lecturers is important as it detects the level of awareness, knowledge, and interest, upon which researches, teaching and other academic endeavour thrive. It is therefore important to assess the perception of lecturers towards GBT as their input is vital in reversing the persisting conventional construction and environmental degrading norm.

Perception is the sum total of a person's position formed by learning, expectation and attention, beyond passive receipt of signals (Bernstein, 2010). According to Schacter (2011) and Goldstein (2009), perception is a sensory action of identifying and interpreting information so as to represent and understand the environment. In this light, environmental education goal can be fostered by lecturers of tertiary institutions; lecturers can serve as catalysts to the adoption of GBT using their advantaged positions of sharing knowledge, engaging in researches for knowledge propagation, and advocating for best practices in constructions. Therefore, this study seeks to answer the questions:

1. What is the perception of lecturers towards adopting GBT in Nigeria construction industry?
2. What is the implication of lecturers' perception of GBT to sustainable construction development and Environmental Education?

Methodology

Area of the study

Anambra State has a population of 4,886,447 distributed across 21 Local Government Areas covering 4,844 km^2. The State is predominately occupied by 98% of Igbo and 2% of Igala tribes. The Eastern Nigerian commercial State is one of the mostly populated states in Nigeria, having urban dwellers of over 60%, surpassing the national average of 36%. The population density is 1,141 persons per square kilometer; this again is higher than the National density of 304 persons per square kilometer (NPC 2002; Anambra State Government, 2017). As such, housing development in the State is among the major investment options for both real estate investors, and business moguls. Also, vision and mission of the State's Ministry of Housing includes to deliver quality, affordable, and sustainable housing system to the people, and to establish a sustainable housing delivery system capable of fostering productivity and socio-economic advancement (Ministry of Housing, 2017).

Anambra State is noted for strides in educational development hence it is not named amongst the educationally disadvantaged States in Nigeria. Its educational attainment stems from the pre-colonial days. The State has eight notable tertiary institutions owned by federal government, state government and privately. These include Anambra State University Of Technology, Uli; Federal College of Education, Umunze; Federal Polytechnic, Oko; Madonna University, Okija; Nnamdi Azikiwe University, Awka; Nwafor Orizu College Of Education; St. Paul's University Awka; and Tansian University, Oba. The State is chosen because of the rate of construction activities, high presence of tertiary institutions with the human resources expected to be engaging in researches relating to sustainable construction, so as to enable Anambra State achieve her mandate of developing and implementing framework to provide housing that will meet the current and future needs of the growing populace.

Study population and sampling technique

The population for this study consisted of all lecturers in the various tertiary institutions, teaching in departments, sections, and centres relating to construction, technology, and environmental management studies. Specifically, the courses from which samples were drawn include the Departments of Architecture, Building Technology/Construction (including vocational education sections), Civil Engineering, Environmental studies, and Urban and Regional Planning. However, snowball non-probability sampling technique was used to obtain a representative sample for this study (Patton, 2001). The sampling technique has been judged appropriate in previous studies in the absence of a sample frame (Darko and Chan, 2018; Zhao *et al.*, 2014), where willingness of the respondents plays a major role (Wilkins, 2011). Snowball sampling method allows the participants to serve as referrals in the gathering of information (Darko and Chan, 2018). As such, lecturers in various institutions in Anambra State were identified through personal contact and were asked to share information with other colleagues in the aforementioned study areas. After five months, only 64 copies, corresponding to 51% of the expected 125 copies were returned duly completed. According to the central limit theorem, a sample size of 30 or above can be used for statistical analysis (Ott and Longnecker, 2001). Again, previous studies involving construction personnel have used samples smaller than 64 (Darko and Chan, 2018; Shen *et al.* 2017; Hwang *et al.*, 2017). Thus, this sample is considered reasonably appropriate to represent the lecturers involved. The detailed information of the participants is shown in Table 1 including field of study, rank, and age range.

Instrument for data collection

The instrument used for the study is a structured questionnaire developed by the researchers. The instrument has two sections. Section A sought demographic information of the respondents, and section B contains 23-item statement, with two response options of *Yes = 2 and No = 1,* which sought information on lecturers' perception of GBT.

In order to establish the reliability of the instrument, Cronbach's alpha test of internal consistency was conducted on the questionnaire. The result revealed reliability coefficient, $\alpha = .807$. Literature shows that a value of at least 0.6 is acceptable; and that the higher the values obtained, the stronger the internal consistency, and reliability of the items (George and Mallery, 2003; Sekaran, 2003).

Procedure

Data collection was through direct administration and retrieval of questionnaire instrument. Data collected were analyzed using simple percentages for

the demographic information, and research question.

Results and Discussion

Table 1 shows the demographic information of lecturers in this study. With respect to field of study, the participants were from courses relating to the environment, those whose impacts are required to transform the prevailing conventional construction styles into the contemporary, sustainable constructions using GBT. The findings revealed that active players are required in the field of engineering, technology, environmental, architecture, and education to ensure adequate training and sufficient supply of the right skilled personnel needed for sustainable constructions. The participants' mix is in accordance with the integrated design approach (Kibert, 2013; Riley *et al.,* 2006) needed to think, and execute sustainable constructions. The multiple disciplines that interlace a building project are exploited through integrated design process, in which the job of designing a building for instance, is beyond the work of just the architects but must involve experts in the environment, construction consultants, the building users and the public.

Also, Table 1 shows the qualification of the participants according to their rankings as lecturers. Among which 25% were professors, 22% were senior lecturers, 19% Lecturer I, 9% Lecturer II, 14% Assistant Lecturer, and others 11%. The "others" therein emerged from differences in lecturers' ranking amongst the three tiers of tertiary institutions covered in this study. For instance, colleges of education have positions for Chief Lecturer whereas such nomenclature does not exist in the Nigerian university system. In addition, the ages of the participants in the Table reveal a fair representation across different ages, indicating that the lecturing career is not mainly dominated by certain age range.

Accordingly, the study found the lecturing profession to be attracted to different age range. This is an important insight as the age of lecturers has influence in their exhibition of subject knowledge, communication, effective teaching, and ability to motivate students among others. Bassey (2016) explained that the younger lecturers are more dynamic to learn new things, whereas the older counterparts are laden with experiences and are more effective in teaching. In the quest for environmental education and sustainability in construction industry, it is more likely that the lecturers aged 21-40 (about 50% of the participants), would champion the movement, hence the ability to learn new things seems tolerant with their age.

Table 2 shows that 100% of the participants indicated 'Yes" to their awareness of the SDGs. However, 56.3% of the participants are not aware of sustainable construction, whereas 84.4% claims to be aware of GBT meant for such purposes. This finding corroborates the findings of World Economic Forum (2019) that 74% of adults globally are aware of the United Nations SDGs. World Economic Forum further reported that SDG goals in line with industry, innovation and infrastructure (Goal 9), and responsible consumption and production (Goal 12) were among the lowest ranked SDGs in terms of awareness globally. Thus, it is not surprising that 56.3% are not aware of SDG application in the construction industry, which

Table 1. Descriptive statistics on the demographic information of the participating lecturers

Class		Number	Percent
Field of study	Engineering	9	14
	Technology	12	19
	Environmental	27	42
	Architecture	10	16
	Education	6	9
Rank	Professor	16	25
	Senior Lecturer	14	22
	Lecturer I	12	19
	Lecturer II	6	9
	Assistant Lecturer	9	14
	Others	7	11
Age	21-30	16	25
	31-40	16	25
	41-50	17	27
	51 & above	15	23

Table 2. Percentage responses of lecturers' perception of GBT in Anambra State

Code	Item Statement	N	Yes (%)	N	No (%)
1	I am aware of sustainable development goals (SDG)	64	100	0	0
2	I am not aware of SDG application in construction industry	36	56.3	28	43.8
3	I am aware of Green Building Technology (GBT) in construction	54	84.4	10	15.6
4	I consider GBT adoption in construction worthwhile	56	87.5	8	12.5
5	GBT is not relevant in construction industry	16	25	47	75
6	I have interest in GBT	57	89.1	7	10.9
7	I do not follow GBT researches	29	45.3	35	54.7
8	I need more orientation in GBT	59	92.2	5	7.8
9	Knowledge of GBT is not widespread	53	82.8	11	17.2
10	I read GBT publications	24	37.5	40	62.5
11	I do not have access to researches on GBT	31	48.4	33	51.6
12	I have published article(s) in line with GBT	15	23.4	49	76.6
13	I am currently working on GBT related publication(s)	20	31.3	44	68.8
14	I can engage in research(es) to promote GBT	45	70.3	19	29.7
15	I encourage students to research on GBT	49	76.6	15	23.4
16	I depend on students for knowledge on GBT	18	28.2	46	71.8
17	Capacity building on GBT can help spread the knowledge	57	89.1	7	10.9
18	I have heard of training / workshop organized for GBT awareness	25	39.1	39	60.9
19	I think GBT is vital for sustainability in building industry	55	85.9	9	14.1
20	I think it is not possible to adopt GBT in Nigeria	17	26.6	47	73.4
21	I make efforts to ensure GBT awareness in class	37	57.8	27	42.2
22	I have attended workshop or training on GB practices	11	17.2	53	82.8
23	I missed attending the organized capacity building on GBT	31	48.5	33	51.6
	Average percent of overall item		**58.4**		**41.6**

affirms the need for GBT information dissemination required by 82.8% of the participants.

Furthermore, greater percentage of the participants, 87.5%, considers the adoption of GBT in construction as worthwhile, while just 25% denied the relevance in construction industry. More so, although 89.1% have interests in GBT, only 37.5% read articles on GBT while 45.3% do not follow researches related to GBT. Owing to the high percentage of participants who have neither published (76.6%), nor are currently working on any research related to GBT (68.8%), the place of more orientation on GBT as inferred by 92.2% of the participants, as well as capacity building on GBT cannot be overemphasized as indicated by 89.1% of the lecturers. The importance of capacity building in achieving the adoption of GBT is in line with the findings of Chukwu *et al.* (2019), who advocated that nations who are well advanced in sustainable construction come to the aid of the developing nations. This gesture will satisfy the quest of 89.1% of the participants who perceived GBT to be relevant and interesting, and equally provide avenue to ensure that greater percentage of lecturers (82.8%) are trained in GBT integration for sustainable constructions and improved environment.

Conclusion

Reversing the impact of the construction industry on the environment is vital in curbing the emission of green house gases, over exploitation of natural resources, global warming, and climate change effects. And driving sustainable construction and environmental education has been found plausible through the instrumentation of training, capacity building, and research and development (Darko and Chan, 2018; Chukwu *et al.,* 2019). But at the helm of training are the higher institutions – where teachers, engineers, environmental specialists etc. are groomed and released for impact in the society. Thus, Fig. 1 illustrates that the lecturers' perception of GBT determines their effort to seek more information, which accounts for their level of interest, and willingness to pursue more knowledge that will enhance teaching and research in sustainable construction and environmental education.

Fig. 1 shows that lecturers' perception of GBT translates to awareness, interest, knowledge, teaching and research. Awareness of GBT for sustainable construction underscores the information lecturers have on the positive and negative impacts, availability of GBT, and how it can be adopted. Information

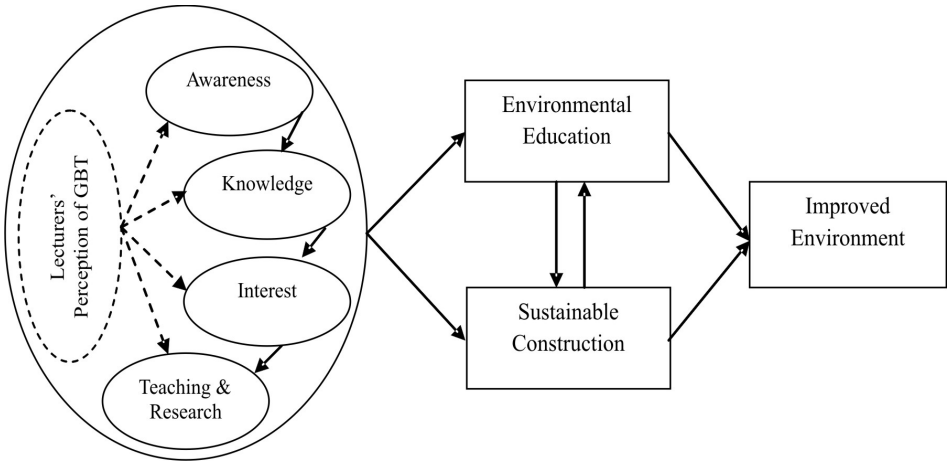

Fig. 1. Implication of lecturers' perception to sustainability and environmental education

on the benefits of GBT certainly should sustain the quest to know more, which proportionally increases knowledge. Sustained interest on the part of the lecturers, certainly outbursts to teaching and propels research among lecturers and the receiving learners. Evidently, lecturers' perception of GBT can positively enhance the teaching and learning of sustainable construction principles, and foster environmental education towards attitudinal changes thereby improving the environment for all.

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