EXPLORING CONSTRUCTION SUSTAINABLE BEHAVIOURS AND THEORY OF PLANNED BEHAVIOUR RELATIONS AMONG UNDERGRADUATES OF CONSTRUCTION EDUCATION

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Abstract
The Theory of Planned Behaviours (TPB) has found wide applications due to the importance of the constructs in relation to behaviours. However, construction sustainable behaviours (CSB) have not been given adequate attention in TPB research. This study explores possible construction behaviours in line with the principles of sustainable construction: reducing resource consumption, reusing and recycling resources, protecting nature, eliminating toxics, applying life-cycle costing, and focusing on quality. Based on questionnaire responses, 144 undergraduates in three Departments related to construction education were surveyed for the study. Descriptive statistics, bivariate correlation, hierarchical multiple regression, and structural equation modelling were used for data analysis. Findings reveal important CSB to include choosing recycled and recyclable materials for construction, integrating renewable energy sources over non-renewable ones, designating a particular place for concrete mixing, and insisting on off-site construction over on-site etc. SEM analysis on the association of TBP constructs with actual CSB shows no significant relationship between attitude and behavioural intentions, in favour of others, thus indicating that the constructs of subjective norms, perceived behavioural control and behavioural intentions play pivotal roles in ensuring that undergraduates of construction education uphold pro-environmental behaviours. We discussed the findings, suggesting practical recommendations, and the implications for construction-related studies and curriculum.

Keywords: Sustainability; construction education, sustainable construction, construction sustainable behaviours; behavioural intentions; theory of planned behaviours

Introduction

Blame upon blame has been heaped on the construction industry over the years. The blame of being the sole consumer of the world's 40% resources, generating 40% of the waste most troublesome to deal with, and off-gassing 35% of greenhouse gases (Luangcharoenrat et al., 2019), has continued for decades. Environmental decay, pollution and excessive exploitation were some terms used to describe the activities of the construction industry due to the conventional approaches of the industry to its day-to-day activities. Conventional construction represents all we know and do to put up structures without attention to waste, alternative materials, recycling, renewable sources of supply, health and productivity of the occupants. The construction industry by its activities impacts the planet, the inhabitants, and the quality of life generally (Han, n.d.). Reversing the sector's impact is said to be a major driver to achieving sustainability in other industries. also, there is fear that anthropogenic activities might bring the earth to a point where living becomes impossible (Perrault & Clark, 2017), hence, the sustainability movement.

Sustainability is a pathway to create all-round balance in society, economy, and environment, now and in the future (WCED, 1987). The need for sustainability in the construction industry spans correcting the menace of generating 35% of greenhouse gases, 40% of waste, and the consumption of 40% of the world's resources (Darko et. al., 2017). A critical step to sustainability in the construction industry that lacks sufficient attention is investigating sustainability behaviours that are pertinent to the construction industry. Carlson and Guevara-Stone, (2013) suggest beginning with the students because, adopting sustainability is preparing for the future. It is important therefore to investigate the undergraduates who would become future managers, contractors, architects, engineers, teachers and collaborators towards achieving sustainability in constructions.

Construction education students encompass all undergraduates whose study focuses on being equipped with knowledge and skills necessary for a role in the construction sector. This area of education include: the civil engineering, architectural sciences, building technology, etc. Construction education students undoubtedly have a strong role in shaping the future of the construction industry, as they are the potential leaders and practitioners who will drive sustainable practices and innovation. The knowledge and attitudes they develop during their educational journey are essential factors to influence their perspectives on environmentally responsible construction techniques and practices. Literature underscores the significance of construction education in fostering a deep understanding of sustainable building methodologies and their implementation (Ayarkwa et al., 2022). Furthermore, Žalėnienė & Pereira, (2021) highlights that education generally plays a vital role in shaping students' attitudes towards sustainability in construction. As the construction industry continues to face the challenges posed by environmental concerns and resource limitations, understanding the attitudes, perceptions, and intentions of construction education students becomes imperative to ensure the integration of sustainable principles into the industry's future endeavors.

There has been a strong call for sustainable construction approaches that result in the development of green or high-performance structures among construction industry players. Consequently, there are studies supporting the sustainable construction adoption mechanisms and strategies to overcome the impeding challenges (Yuriev et al., 2020; Darko & Chan, 2018). Part of the strategies is the adoption of the sustainable construction principles. Kibert (2013) defines seven principles of sustainable construction, which find application in the planning, developing, design, construction, use and maintenance, repair, renovation, and deconstruction stages to include: reducing resource consumption, reusing and recycling resources, protecting nature, eliminating toxics, applying life-cycle costing, and focusing on quality.

Correspondingly, there is move in line with education for sustainable development agenda (ESD) to ensure that every human being acquires the knowledge, skills, attitudes and values necessary to shape a sustainable future (UNESCO, 2018). ESD simply advocates the inclusion of SD issues in teaching and learning, which the higher education has championed, thus projecting the acquisition of sustainable/pro-environmental behaviours among students (Tang, 2018; Whitley et al., 2018). Literature has noted the place of higher education in ensuring that undergraduates are positioned to play vital roles for sustainability in the society after graduation (Tang, 2018). Typically, sustainability behaviours have been studied in different contexts, but with attention to general behaviours that are not targeted at the construction industry (e.g., Corral-Verdugo et al., 2021; Inkpen & Baily, 2020; Sierra-Barón et al., 2021; Whitley et al., 2018; Xu et al., 2020). Some sustainable behaviours explored in previous studies include – turning off the light when leaving the room, choosing restaurants that serve organic foods, carpooling, recycling etc. Although, recycling finds application in building construction, the focus of previous studies on pro-environmental behaviours has never been towards constructions. Hence, we lack studies that explored construction sustainable behaviours, and little is known of what actions are expected of the players to achieve sustainability in the construction industry.

Steg and Vlek (2009) defined sustainability behaviour as all possible actions aimed at avoiding harm to and/or safeguarding the environment. Construction sustainable behaviour (CSB) refers to actions taken to create buildings and environments that are in line with sustainable construction principles of reducing resource consumption, reusing and recycling resources, protecting nature, eliminating toxics, applying life-cycle costing, and focusing on quality (Kibert, 2013). Thus, CSB implies insisting on a shift from the traditional or conventional methods of construction, to integrate outlooks and behaviours capable of minimizing the impact of constructions on the environment for the benefits of now, and the indefinite future. CSB is vital, as radical behavioural changes are necessary in achieving sustainability in the construction industry (Darko & Chan, 2018).

One of the strongest and most used theoretical supports for intention towards behaviours is the Ajzen's Theory of Planned Behaviours (TPB). With the concepts of three direct predictors: attitude (personal favourable and unfavourable sustainability positions), subjective norm (influence of social referents, like lecturers, supervisors), and perceived behavioural control (a personal belief in the ability to execute a behvaviour), we relied on TPB to investigate the students' intentions towards sustainability in this explorative study (Ajzen, 1985, 1991). According to TPB, the construction sustainable behaviours expected of the construction education students would be significantly associated with intentions and perceived behavioural control. Intention is the student's drive to engage in CSB as opportunities occur in different settings, and is dependent on attitude, subjective norm, and perceived behavioural control. Subsequently, CSB (behaviours) are the actions/activities necessary to achieve sustainability in the construction industry.

Overall, this study aims to contribute to the increasing sustainable behaviour and sustainability literature by testing the acceptance of construction sustainable behaviours, and its association with the variables of TPB. Subsequently, we discussed the research method adopted, findings, and discussed these findings with an evaluation of contributions and implications.

Hypotheses

In keeping with the TPB relationships among intentions, attitude, subjective norm, and perceived behavioural control, and based on previous researches (Swaim et al., 2013; Yuriev et al., 2020), we adapted Figure 1 and hypothesize thus:

1. Sustainability attitude will be significantly associated to student's behavioural intentions towards sustainability
2. Positive subjective norms toward sustainability will be significantly associated to student's behavioural intentions towards sustainability.
3. Student's perceived behavioural control towards sustainability will be significantly associated to student's behavioural intentions towards sustainability.
4. Student's perceived behavioural control towards sustainability will be positively related to actual construction sustainable behaviours.
5. Students' behavioural intentions towards sustainability will be positively correlated with construction sustainable behaviours.

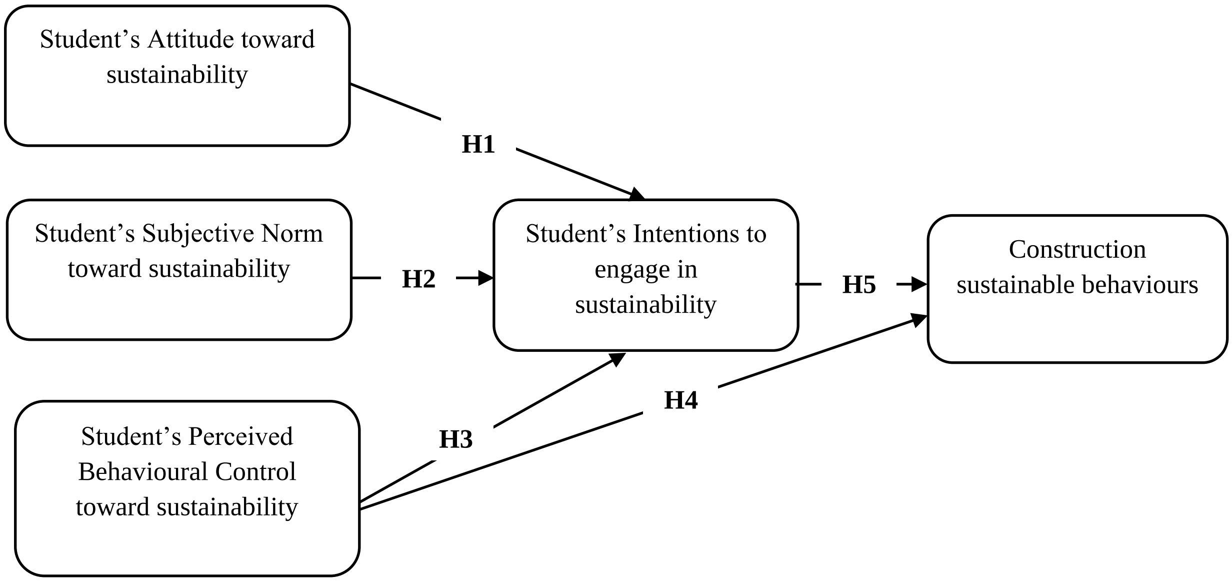

Figure 1: The Hypothesized Model of TPB and Construction Sustainable Behaviours

Method

Participants and procedure

Construction education students in three departments (Architecture, Civil Engineering, and Building Technology Education) in University of Nigeria, Nsukka participated in the study. Due to the diverse locations of the students, Google-form was used to complement paper and pen version of the instrument. While students in Enugu Campus of the University of Nigeria (Department of Architecture) were asked to complete the form online, the instrument was administered directly to those in Nsukka Campus, and retrieved immediately after completion. Also, while a research assistant, who was briefed of the details of the study coordinated the online-based data collection (explaining to lecturers, and working with the class representatives to ensure compliance from students), the researchers administered directly to a convenient sample of 57 students in civil engineering and building technology education. A total of one hundred and forty-four (144) responses, both offline and online, were valid for the analysis, and was coded without any identity information of the students to ensure their anonymity and confidentiality. MS-Excel was used in the organization and coding process, while SPSS version 26 was used for the analysis. Demographic data show that 36.1% (52) of the participants are from Architecture, 38.9% (56) from Civil Engineering, and 25% (36) are from Building Technology Education. Also, 13.9% (20) of the participants are 16–18 years, 31.3% (45) are 19–21 years, while 54.9% (79) are between 22 years and above. In terms of level of study, 61.1% (88) are final year students, and 38.9% (56) are in penultimate years. Penultimate years of the students vary according to their different programs. Architecture and Building technology education offer three-year/four-year programs for B.Sc. degree, while Civil engineering offer four-year/five-year program for B.Eng. degree. Thus, the penultimate years cover those in 200L for three-year course, 300L for four-year course and 400L for those in five-year course. The final designate is however, very clear. We considered these two levels appropriate for the study for certain reasons: (1) there are no indications that sustainability was part of the students' curriculum, (2) students' knowledge and/or experience of sustainability may be based on chance/incidental exposure (Swaim et al., 2013) (3) students in final and in penultimate years in the various departments have been exposed to workplace learning during their period of students' industrial work experience.

Measures

Section A of the instrument comprised of student's department, age, and level of study. Section B measured CSB, attitude, subjective norm, perceived behavioural control, and behavioural intention constructs (see Appendix). The Construction Sustainable Behaviours questionnaire (CSBQ) comprises of 20-item scale, derived from extensive literature review of the sustainability behaviour and sustainable construction principles. The participants were required to indicate the degree to which behaviours were vital toward achieving sustainability in the construction industry, based on 5-point Likert scale of 'very important' (5) to 'not important.' Scales for TPB constructs for attitude, perceived behavioural control and behavioural intentions were adapted from the refined adaptation of (Swaim et al., 2013), while norm scale was adapted from (Whitley et al., 2018). The attitude scale has 5-items to ascertain how favorable the students judge the CSB potentials, measured on 5-point Likerts of 1 = strongly disagree and 5 = strongly agree. The subjective norm scale was a 5-item scale asking the students to 'indicate the extent to which you agree or disagree with the each of the statements…"

Also, the PBC scale has 5-items asking individuals to indicate the extent which they agree or disagree with the statements. Four items were used to construct the behavioural intention scale. Similar to the Norm and PBC scales, individuals were asked to 'indicate the degree to which they disagree or agree with each of the following statements…' The participants responded to the statements in the scales using a 5-point Likert scale from 'strongly disagree = 1' to 'strongly agree' = 5. Cronbach alpha reliability coefficient was used to test the reliability of the scales. Overall reliability coefficient of .851 was obtained; the respective reliability coefficient of the scales showed: CSB scale = .795; attitude scale = .922; subjective norm = .752; PBC = .810; and intentions = .780.

Data Analyses

The research used SPSS for descriptive statistics and hierarchical multiple regression (HMR) analyses, while structural equation modeling (SEM) was used to test the model. Descriptive statistics was necessary in establishing construction students' acceptance of CSB as important or not important in the quest towards sustainability. It was also necessary in order to ascertain the mean and standard deviation of the scales using descriptive statistics. HMR gives room for testing hypotheses 1 – 3, and establishing the role of behavioural intentions in stirring actual CSB. Five models were used, in which we introduced the control variables (Department, level of study, and age), in model 1, to control for the impact on the dependent variables. In the second, third and fourth models, attitude, subjective norms, and perceived behavioural controls were introduced respectively to determine the extent of prediction each has on the students' actual CSB. Students' behavioural intentions construct was added in model 5. Also, to be able to simultaneously test the model, and estimate the structural coefficients, as well as the direct and indirect influences (Liao, et al., 2022) of behavioural intentions on perceived behavioural control, attitude and subjective norm towards CSB, we used the SEM of AMOS version 23.

For analysis using AMOS, we first checked for missing values and found 0%; we further scaled-up the 20-item CSB scale with reliability of $\alpha = .795$, using SPSS 'scale if item deleted' to achieve 8-items with $\alpha = .852$. The pruning was necessary as AMOS will not accept

20-observed variables for a construct. The constructs of the model used in AMOS had: CSB = 8-items; Attitude = 5-items; Subjective norms = 5-items, perceived behavioural control = 5-items; and behavioural intentions = 4-items. Thus, AMOS version 23 was used to perform the confirmatory factor analysis (CFA) with the aim of obtaining satisfactory fitting indices, before carrying out a SEM analysis for the hypotheses. Generally, AMOS uses the maximum likelihood extraction method, thus, all estimated parameters were continuous, and were significantly different from 0 at a 95% confidence level ($p < 0.05$) (Barret, 2007). Targeted indices were to satisfy literature established model fit index values including: the chi-square to degrees of freedom (CMIN/DF), recommended to be between 1 and 3; comparative fit index (CFI), and Tucker Lewis Index (TLI) which are said to be above 0.90 to indicate a good model; root-mean square error of approximation (RMSEA), expected at about 0.06 – 0.08, among others. Direct and indirect effects were ascertained using 5000 re-samples bootstrapping method (Bollen & Stine, 1992; Lockwood & MacKinnon, 1998).

Results

The data in Table 1 show the respondents' rating of the importance of construction sustainable behaviours (CSB). Based on average mean value of 3.50 (for a 5-point scale), all the items have mean values above the average, including the cluster mean of 4.04. It could be deduced that the respondents affirm that the 20-items are important behavioural actions necessary to stir sustainability in construction sites. Among the items, "integrating renewable energy sources over the non-renewable" (item 7) with mean value of 4.36, is judged the most important action, while "admitting adequate natural ventilation and lighting into the usable spaces" (item 17) has the lowest mean of 3.59, though it is still an important behaviour for sustainability in the construction industry.

Table 1: Construction sustainable behaviours, mean and standard deviation

Items	Mean	SD	Decision
SB1	3.86	1.11	Important
CSB2	3.82	0.98	Important
CSB3	4.51	0.85	Very Important
CSB4	4.29	0.62	Very Important
CSB5	4.18	0.83	Very Important
CSB6	4.13	0.64	Very Important
CSB7	4.36	0.89	Very Important
CSB8	4.02	0.70	Very Important
CSB9	4.05	0.79	Very Important
CSB10	4.13	0.78	Very Important
CSB11	4.12	0.86	Very Important
CSB12	4.07	0.84	Very Important
CSB13	4.13	0.84	Very Important
CSB14	4.10	0.81	Very Important
CSB15	3.96	0.96	Important
CSB16	4.18	0.81	Very Important
CSB17	3.59	0.91	Important

CSB18	3.67	1.03	Important
CSB19	3.76	1.08	Important
CSB20	3.78	1.00	Important
CSB cluster	**4.04**	**0.40**	**Very Important**

In Table 2, the bivariate analyses indicated that attitude (r = .337, p = .01), subjective norm (r = .315, p = .01), perceived behavioural control (r = .397, p = .01), and behavioural intentions (r = .731, p = .01), are significantly, and positively linked with CSB. These necessitated the need to verify the extent to which the explanatory variable account for the relationship with the dependent variable using HMR.

Table 2: Bivariate correlation of variables, descriptives and reliability estimates

Variables	Mean	SD	1	2	3	4	5	6	7	8
Department	1.92	0.74								
LevelofStudy	1.40	0.49	-.041							
Age	2.40	0.71	.389**	-.143						
CSB	4.04	0.40	-.128	.119	-.047	(.795)				
Attitude	3.71	0.91	.210	.066	.188	.337**	(.922)			
SubjNorm	3.83	0.61	-.128	.119	.019	.315**	.738**	(.728)		
PerBahCo	4.33	0.43	-.057	.040	.020	.397**	.168	.215	(.810)	
BehavINT	4.09	0.64	-.296**	.075	.011	.731**	-.047	.052	.279*	(.780)

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed). SubjNorm = Subjective Norm; PerBahCo = Perceived Behavioural control; BehavINT = Behavioural intentions; CSB = construction sustainable behaviours

Table 3: HMR analysis predicting actual Construction Sustainable Behaviours

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
	β	B	β	β	β
CVs					
Department	-.131	-.191	-.193	-.193	.084
Level of study	.117	.082	.087	.087	.017
Age	.020	-.032	-.041	-.041	-.156
IVs					
Attitude		.378	.420	.421	.386
Subjective Norm			-.067	-.069	-.007
Percieved Behav.Ctrl				.011	.052
Behavioural Intentions			.734		.778
R^2	.030	.163	.166	.166	.698
R^2_{change}	.030	.134	.003	.000	.532
F-value	$F(3,140)$ = .806	$F(4,139)$ = 3.807	$F(5,136)$ = 3.066	$F(6,137)$ = 2.524	$F(7,136)$ = 24.756
F_{change}	.806	12.461	.248	.011	132.037
p-value	.494[b]	.007[c]	.014[d]	.028[e]	.000[f]

We used hierarchical multiple regression to ascertain the direct influence of attitude, subjective norms, perceived behavioural control, and behavioural intention on the actual construction sustainable behaviours. In Table 3, the demographic variables (control variables) in model 1 accounted for accounted for 3% variance in construction education students' CSB, $R^2 = 0.030$, $\Delta F(3,140) = .806$, p = .494 (not significant). The inclusion of attitude along with the control variables, in model 2, shows $\Delta R = .134$, $F(4,139) = 3.807$, $P = 0.007$ (significant). Thus, attitude accounts for 13.4% of the variance. In model 3, subjective norm is introduced, and is significant at $p < 0.05$, $\Delta R = .003$, $F(5,136) = 3.066$. Furthermore, the addition of PBC was significant at $p < 0.05$, $\Delta R = .000$, $F(6,137) = 2.524$, thereby making no difference in the CSB variance. In Table 3, addition of behavioural intentions turned the models around in model 5, accounted for a significant 53.2% variance in students CSB, $R^2 = 69.8$, $F(7,136) = 24.756$, $p < 0.000$. Summarily, the models 1-4, (excluding the addition of behavioural intentions), explained a total variance of 16.6% in actual CSB. It is evident from Table 3 that subjective norm has very little effect on CSB. Likewise, PBC was seen to have caused no changes on students' CSB. However, attitude and perceived behavioural control are significantly related to construction sustainable behaviours.

Table 4: Summary of model validity and reliability

Variables	CR	AVE	1	2	3	4	5
Attitude	0.907	0.662	**0.814**				
SubjNorm	0.732	0.481	0.488***	**0.694**			
PerBahCo	0.913	0.676	-0.119	0.663***	**0.822**		
BehavINT	0.819	0.477	-0.021	0.203†	0.224*	**0.690**	
CSB	0.853	0.423	0.052	-0.068	-0.040	0.132	**0.650**

Significance of Correlations: † p < 0.100, * p < 0.050, ** p < 0.010, SubjNorm = Subjective Norm; PerBahCo = Perceived Behavioural control; BehaINT = Behavioural intentions; CSB = construction sustainable behaviours

Table 4 shows the overall validity analysis for the measurement model in SEM. A measurement model was tested for the adequacy of its fit to the sample data with maximum likelihood estimation. Using AMOS for confirmatory factor analysis (CFA), the final TPB model fit recorded was CMIN = 426.364, DF = 289, CMIN/DF = 1.475, RMSEA = 0.058, CFI = 0.923; TLI = .914, and IFI = .925, which according to (Schumacker & Lomax, 2004) are parameters of a good fit. The composite reliability (CR) values were all above 0.70, as shown in Table 4. Although the average variance extracted (AVE) were below 0.5 for three variables, (Malhotra & Dash, 2011) had suggested that reliability can be established through CR alone, and that AVE is often too strict. To that effect, discriminant validity (across the diagonal in Table 4) shows adequacy of the model.

Furthermore, Table 5 confirms the factor loading of the variables of the constructs. All variables have factor score above .50, *t-values* were all above 1.0, and all items were significant at 0.001, necessitating being retained in the analysis

Table 5: Factor loading of the variables

Construct	Item	Loading	T	Sig.
Attitude	ATT5	.808		
	ATT4	.790	10.493	***

Construct	Item	Loading	T	Sig.
	ATT3	.839	11.376	***
	ATT2	.821	11.047	***
	ATT1	.810	10.854	***
Subjective Norm	SN3	.559	6.114	***
	SN2	.770	8.245	***
	SN1	.733		
Perceived Behavioural Control	PBC5	.784		
	PBC4	.848	11.159	***
	PBC3	.818	10.661	***
	PBC2	.852	11.227	***
	PBC1	.807	10.474	***
Behavioural intentions	BINT5	.630		
	BInt4	.738	6.754	***
	BInt3	.749	6.815	***
	BInt2	.689	6.456	***
	BInt1	.637	6.099	***
Construction sustainable behaviours	CSB5	.631		
	CSB4	.702	6.804	***
	CSB3	.692	6.733	***
	CSB2	.545	5.562	***
	CSB1	.537	5.492	***
	CSB6	.658	6.474	***
	CSB7	.745	7.101	***
	CSB8	.662	6.506	***

Lastly, for the SEM we used a bootstrapping method of 5000 resamples to verify the hypotheses in the model. The output results shown in Table 6 has the corresponding path coefficients, t-values and p-values. The hypothesis verification results presented in Table 6 shows that attitude had no significant positive relationship with behavioural intentions (β = -0.102, t = -1.441, $p > 0.05$); thus, H_1 was rejected. Subjective Norms had a significant positive relationship with behavioural intentions (β = 0.195, t = 2.367, $p < .05$); thus, H_2 was accepted. Perceived behavioral control (PBC) had a significant positive relationship with behavioural intentions (β = 0.137, t = 2.273, $p < 0.05$); thus, H_3 was accepted. The relationship between PBC and CSB was significant (β = -0.049, t = -0.845, $p < 0.05$); hence, H_4 was accepted. Additionally, behavioural intentions had a significant positive relationship with CSB (β = 0.146, t = 1.434, $p < 0.05$); therefore, H_5 was accepted.

Table 6: Hypotheses

Hypothesis	Estimate	S.E.	*t-value*	*p-value*	Decision
Attitude → BehavINT	-.102	.071	-1.441	.150	Rejected
SubjNorm → BehavINT	.195	.083	2.367	.018	Accepted
PerBahCo →	.137	.060	2.273	.023	Accepted

Hypothesis	Estimate	S.E.	*t-value*	*p-value*	Decision
Attitude → BehavINT BehavINT	-.102	.071	-1.441	.150	Rejected
PerBahCo → CSB	-.049	.057	-.845	.039	Accepted
BehavINT → CSB	.146	.062	1.434	.015	Accepted

Note: SubjNorm = Subjective Norm; PerBahCo = Perceived Behavioural control; BehavINT = Behavioural intentions; CSB = construction sustainable behaviours

Discussion

In the context of today's global environmental challenges, especially as it touches the building construction industry, the importance of construction sustainable behaviors (CSB) cannot be overstated. Sustainable behaviours in construction are essential for mitigating environmental impacts, conserving resources, and promoting long-term economic viability (Ayarkwa et al., 2022; Lima et al., 2021). By prioritizing CSB, the construction industry professionals can reduce carbon emissions, minimize waste generation, and optimize energy efficiency, contributing significantly to climate change mitigation efforts (Akadiri et al., 2012; Amaral et al., 2020; Yang et al., 2023). Moreover, CSB is expected to lead to cost savings (Ma, 2011), through reduced energy consumption and lower operating expenses over a building's lifespan, making them economically attractive (Yang et al., 2023). Furthermore, embracing sustainability enhances an organization's reputation and competitiveness in a market increasingly sensitive to environmental concerns (Sun et al., 2022). Overall, construction sustainable behaviors are not only environmentally responsible but also financially prudent, ensuring a resilient and sustainable future for the industry and the planet.

This study revealed an intriguing outcome with respect to the association between attitude and behavioural intentions. Although attitude has traditionally been assumed to serve as a strong predictor of individuals' intentions to engage in a specific behaviour, our finding challenges that assumption. The outcome of this study is however not far from the findings of both old and recent researches which suggested the absence of a substantial relationship between the two constructs. For instance, (Bagozzi, 1992) argued that attitude does not sufficiently determine intentions towards an action. A recent study by Verplanken & Orbell, (2022) also echoed that attitude is insufficient in leading to changes in behaviours in all contexts. On the other hand, Dwivedi et al., (2019) underscored the central role of attitude in behavioural changes. Despite the path a study takes, usually findings shed light on a new perspective, which in this case strongly suggests that external factors, contextual cues, and individual characteristics might play a more significant role in shaping behavioural intentions than previously assumed attitude, emphasizing the need for a more nuanced understanding of the attitude-behaviour relationship. One of the characteristics playing key role in attitude-behaviour relationship might be the subjective norms.

The identification of a substantial correlation between subjective norms and behavioural intentions underscores the pivotal role that social influences and external pressures play in shaping individuals' intentions to engage in specific actions. Research also corroborates with the significance of subjective norms as a predictor of behaviour, challenging the notion that individual attitudes alone are the primary drivers of intentions. The study conducted by Jung et al., (2020) investigated the relationships among beliefs, attitudes, time resources, subjective norms, and intentions to use wearable augmented reality in art galleries. The study's findings demonstrated a strong positive relationship between perceived social expectations and the intention towards wearable augmented reality. In understanding the role of subjective norms in the context of adopting sustainable practices, Van Tonder et al., (2023) found that customers were more likely to engage in sustainable behaviours that are endorsed by their social networks. Accordingly, the finding of this study highlights the influential power of social norms in driving behavioural intentions, underscoring the need to consider both personal attitudes and social contexts in understanding and predicting human behaviour.

Furthermore, we found a noteworthy relationship between perceived behavioural control and behavioural intentions towards construction sustainable behaviours, underscoring the crucial role of self-efficacy and perceived control in shaping individuals' intentions to engage in sustainable behaviours within any construction space. Recent research has highlighted the significance of perceived behavioural control as a determinant of behavioural intentions, complementing the established Theory of Planned Behaviour framework. For instance, a study by (Tunji-Olayeni et al., 2023) on the factors influencing intentions to adopt green construction revealed a positive correlation, indicating that higher levels of perceived control were linked to more favorable intentions to adopt green construction. The study by Guo et al., (2022) found that when individuals felt a greater sense of control over waste reduction actions, they exhibited stronger intentions to enact those behaviours. Deductively, PBC plays a vital role in influencing intentions to uphold sustainable actions in construction settings. Thus, one strategy for fostering environmentally friendly behaviours could be to enhance individual's confidence and control perceptions to sustainable actions.

In addition, the substantial relationship between perceived behavioural control and actual construction sustainable behaviours further underscores the pivotal role of self-efficacy and perceived control in translating intentions into concrete actions within the construction industry. The interconnectedness of PBC and intentions towards a behaviour has been established in literature (Long She et al., 2023), hence the findings of this study is supported Recent research has illuminated the significance of perceived behavioural control as a catalyst for transforming behavioural intentions into real-world practices, complementing established theoretical frameworks. For instance, a study by Chen & Tung, (2014) explored the connection between construction workers' perceived control over adopting energy-efficient construction techniques and their subsequent implementation of sustainable practices. The findings revealed a robust positive correlation, suggesting that higher levels of perceived control were associated with a greater likelihood of engaging in energy-efficient behaviours. The study demonstrated that when individuals felt more in control of adhering to safety measures, they exhibited a higher degree of compliance with those measures. These studies underscore the pivotal role of perceived behavioural control in bridging the intention-behaviour gap in the realm of construction sustainable behaviours, which further emphasizes the need to enhance individuals' sense of control to promote the adoption of sustainable behaviours.

Lastly, this study found a significant relationship between behavioural intentions and actual construction sustainable behaviours. It underscores the fundamental role of intentions in predicting and influencing individuals' actions within the construction industry. There are collaborative researches which highlighted the predictive power of behavioural intentions as a precursor to tangible behaviours (Maqsoom et al., 2023; Tunji-Olayeni et al., 2023). Among construction professionals, Maqsoom et al., (2023) found that stronger intentions and other psychosocial factors associated with higher engagement in sustainable behaviours. Thus, efforts must be made to target and enhance the intentions of students in construction studies, in order to promote the adoption of sustainable behaviours within and outside the building construction sites.

Conclusion and Implications

The findings highlighting the significant relationship between various psychological factors and sustainable behaviours in the construction industry hold crucial implications for both construction-related studies and curriculum development. These findings emphasize that understanding and addressing the psychological determinants of behaviour, such as attitudes, subjective norms, perceived behavioural control, and intentions, are essential for promoting sustainable practices in construction settings. Incorporating these insights into construction-related studies allows researchers and practitioners to design interventions that target these psychological factors, ultimately bridging the intention-behaviour gap and fostering the adoption of sustainable practices among construction professionals. Moreover, these findings suggest a need to revise construction-related curricula to include modules or courses that delve into the psychological aspects of behaviour change, offering students a comprehensive understanding of the drivers behind sustainable actions. Integrating topics related to attitude formation, social norms, self-efficacy, and intention-behaviour relationships into construction education can equip future professionals with the skills and knowledge needed to effectively advocate and implement sustainable practices in real-world construction projects. By acknowledging the significance of psychological factors and integrating them into both research and education, the construction industry can progress towards a more environmentally conscious and sustainable future.

Conflict of Interest:
The authors declare no conflict of interest.

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APPENDIX

Please indicate your best response to the following sustainability related issues and behaviours. Be assured that all responses will be treated with strict confidentiality, and anonymity is assured.

Section A:

1. What level are you?
   200 Level ☐ 300 Level ☐ 400 Level ☐

2. How old are you?
   16 Years or Less ☐ 17 – 20 Years ☐ Above 20 Years ☐

3. Department ____

Section B:

Construction Sustainable Behaviours (CSB) Scale

Please indicate how important these behaviours are to you with regards to constructions:

(Extremely Important -EI = 5; Very Important -VI = 4; Moderately Important -MI = 3; Slightly Important -SI = 2; Not at All Important -NI = 1)

S/N	How important is:	EI	VI	MI	SI	NI
1	Reducing 10% extra materials bought to account for waste in construction					
2	Reusing broken debris and excavated soils used for fillings					
3	Choosing recycled and recyclable materials for constructions					
4	Designating a particular place for concrete mixing					
5	Insisting on off-site construction over on-site					
6	Avoiding the disposal of debris from broken walls in any nearby bush or river					
7	Integrating renewable energy sources over the non-renewable					
8	Verifying material life-cycle costing against immediate performance					
9	Ensuring that constructions are in compliance with relevant legislations and regulations					
10	Manufacturing or sourcing construction materials locally as a standard					
11	Metering or calculating water & energy consumption					

	during construction					
12	Insisting on green technologies, judging on quality over cost					
13	Improving prior experiences and performance in construction management					
14	Early assessment of land, environment, and proposed construction activities					
15	Using integrated design approach in construction development					
16	Retaining nature as much as possible in construction sites					
17	Admitting adequate natural ventilation and lighting into the usable spaces.					
18.	Sorting waste on-site, avoiding burning					
19.	Restoring brownfields, and contaminated fields for structures					
20.	Creating avenue for water storage & recycling					

Please indicate the degree to which you disagree or agree to the following statements:
(Strongly Agree -SA =5; Agree -A = 4; Undecided = 3; Disagree -D = 2; Strongly Disagree -SD = 1)

S/N	**Attitude-based statements**	**SA**	**A**	**U**	**D**	**SD**
1	In my opinion, it is important to adopt sustainability practices in construction					
2	I actively affirm to practice construction sustainable behaviours at sites (e.g., designating a particular area for concrete mixing, metering water consumption on site etc.)					
3	It is the responsibility of everyone involved in construction to work toward sustainability attainment					
4	I am concerned about the long-term future of the world without sustainability practices					
5	In my opinion, it is important to conserve natural resources, even in construction sites					
	Norm-based statements					
6	I am in for sustainability once my friends and other students support sustainability actions.					
7	Except where there is law, I will go on with construction as usual					
8	My lecturers are keen about actions towards sustainability, so I will join					
9	Pleasing my clients and lecturers influence my stance for sustainability					
10	My family members think sustainability is the way forward					
	PBC-based statements					
11	It is easy for me to perform construction sustainable activities (e.g., designating a particular area for					

	concrete mixing)					
12	I have control over my actions towards engaging in construction sustainable behaviours					
13	It is my decision whether or not to perform the construction sustainable activities					
14	I have the ability to carry out construction sustainable activities					
15	I have control over performing construction sustainable activities					
	Intention-based statements					
16	I am likely to increase construction sustainable activities (e.g., designating a particular area for concrete mixing) in the workplace					
17	I am likely to seek more opportunities to be more sustainability compliant in the future					
18	In the future, I plan to look into how I can play a greater role in ensuring that sustainable construction practices are adopted in sites					
19	I am likely to choose green or sustainable products than the conventional when I am in charge of a construction					