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# The Effect of Facilities Management Services on The Physical Learning Environment of Technical Universities in Ghana

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**Abstract**

Purpose – The quest to provide quality education has led to the need to enhance performance and maintain the quality of the physical learning environment through Facilities Management (FM) service delivery. This paper seek to assess the effect of FM service delivery on physical learning environment of technical universities in Ghana.

Design/methodology/approach – This study adopts explanatory sequential mixed methods design which involves a general questionnaire survey followed by interviews in six technical universities in Ghana. Partial Least Square structural equation model (PLS-SEM) was used for the quantitative analysis whereas thematic analysis following the six-step procedure by Braun, & Clarke, 2006 was used for the qualitative analysis.

Findings – The results established a statistically significant relationship between health and safety, lighting and physical learning environment while exhibiting an insignificant relationship for noise, cleaning service, temperature and ventilation and physical learning environement. Investigation through interviews revealed inadequate FM staff, lack of policies, ineffective monitoring of service delivery, poor acoustic condition of facilities were major reasons for students dissatisfaction with FM services delivery.

Practical Implication - The results highlight the relevance of FM services to improve the physical learning environment of technical universities while providing the critical evidence of the need to improve FM services to enhance teaching and leaning.

Motivation and Contribution – Technical university education and FM are key in addressing current global skills gap. The study enlightens on theoretical knowledge in FM useful to developing economies where the concept is egressing. This study is one of the few that investigates the effect of FM services on the physical learning environment from students' perspective. Introduction and testing of new dimensions of variables for core facilities services is essential in improving teaching and learning in technical universities in Ghana and by extension to analogous institutions in developing countries of Africa.
**Keywords:** Facilities Management, Physical Learning Environment, Hard FM Services, Cleaning Services, Ghana, PLS SEM

**Introduction**

There is an underlying need for Higher Education Institutions (HEI) to pay more attention to students needs in terms of facilities services delivery due to its impact in shaping the physical learning environments (PLE) which serves as a stimuli to enhance students learning and outcomes. Higher education institutions (HEI) have become active and valuable partners towards the attainment of the United Nation's goals for sustainable development (SDG's) through its contribution in promoting healthy live and wellbeing of students, ensuring inclusive and equitable quality education which also serves as a pivot for enhancing economic growth and putting an end to poverty in developing economies. To create a resilent manpower for national development, technical universities were set up by the Technical Universities Act of 2016 (Act 922) which transformed the Polytechnics into Technical Universities to train the needed hands on middle and higher level manpower to facilitate Ghana's economic growth.

Unarguably, a well-maintained and safe educational PLE coupled with quality FM service delivery can not be over looked if Technical Universities are to realise their objectives and to survive in the highly competitive market. FM plays an important role in achieving the goals of the university by providing students and staff with the required physical environment to support academic and practical work (Kärnä et al., 2013). Nonethless, like all HEI's, technical universities are grappling with issues of funding, the need to widen access and fill gender gaps in targeted disciplines (Ferguson & Roofe, 2020). These challenges poses facilities implications globally for which Ghana is no exception; especially, how to effectively manage ageing and expanding facilities to suit changing needs (Marmolejo et al., 2007).

Technical Universities in Ghana are confronted with issues of inadequate and poorly managed facilities which sometimes raise the question as to whether they have the requisite capacity to support the training of higherly skilled manpower for the development of the country. Poor maintenance culture have left equipment such as airconditioners and ceiling fans faulty, there exist substandard cleaning services, broken lavatories amongs others. Certainly, attention has not been paid to their physical learning environment; especially, from the students perspective (Acquah et al., 2017a). In the wake of the numerous challenges faced by Technical Universities in developing countries, a number of studies has been conducted. Reserach by Sapri et. al (2017) investigated the implementation of energy management key practices in six higher education institutions in Ghana; Acquah et al (2017a, 2017b) and Larbi and Gyedu (2021) focused on curriculum developement, Anane and Kwarteng (2019) delved into procurement performance measurement in Technical Universities while Akpey-Mensah (2020) study focused on improving technical universities performance using social capital

development as innovation in human resource development. Badoo et al (2020) studied on the assessment of internal control systems to improve Technical Universities performance. There are limited research on effects of facilities management services on the physical learning environment.

This study seeks to assess the effect of facilities management services on the physical learning environment of technical universities in Ghana. Addressing these gaps will provide knowledge and empirical evidence for national education authorities and technical university management to drive effective policies and strategies towards improving FM services delivery in universities to enhance teaching, learning and research required to sustain Ghana's economic development and achievement of SDG's. Addressing the FM service delivery challenges and improving the physical learning environment subsequently, is useful to improve the core skill gaps demanded by technical education training which has indirect effect of reducing national unemployment as well as build an ambient and resilent academic environment for the rising student numbers in future.

## Literature Review

### Physical Learning Environment

Students perception about their physical learning environment (PLE) is a strong predictor of their learning outcomes (Asiyai, 2011). Studies have shown that good conditions of the PLE such as lighting, temperature, ventilation, cleaning, acoustics facilitate students level of concentration, motivation, health , wellbeing and comfort which are prerequisites for learning. Fundamentally, effective learning requires a conducive physical learning environment that can motivate students to aim higher in educational achievements and outcomes (Amanullah & Adeeb, 2014). Asiyai (2011) carried out a study to examine the perception of students on their classroom physical learning environment and its impact on their learning and motivation. The results showed that condition of classroom physical learning environment had enormous influence on students' learning and motivation, especially the motivation to actively contribute in academic work.

Nworgu (2006) is of the view that physical environment must assure the health and wellbeing of its users by providing for good lighting and ventilation in clean environment. An environment with poor indoor air quality may stir the presence of bacteria and molds. For example, Bates (1996) found in a study that users of the physical environment complained of allergy symptoms associated with sick building syndrome due to relative humidity level exceeding seventy two percent (72%). Several authors have conducted research to support the argument that physical learning environment has an effect on students' comfort and performance. Lowe (1990) found suitable classroom temperature important in providing the needed comfort to stimulate student's performance. It is also imperative to note that Cash (1993) found comfortable issues in the physical environment to have significant effect on student achievement when he studied the relationship between the physical learning environment, students' achievement and behavior.

Concentration during learning process still remains crucial for effective learning and successful outcomes. Sleegers et al (2013) suggest a favorable learning environment for students to maximize means to improve their learning concentration. In a review of several studies by Tanner (1999) emerged that suitable lighting in the physical environment enhances

student's concentration and test scores. There are also studies which suggest the ability of innovative physical environment towards improving learning opportunities in a variety of ways by enhancing participation, and allowing students to work with more classmates than they would in traditional classrooms (Gurzynski-Weiss et. al., 2015). The analogy with quality education is that education achievement is partly due to the conducive nature or attributes of the physical learning environment in which the academic and practical work takes place. In sum, the review highlights promoting physical and emotional health, ensuring comfortability, supporting students motivation, concentration and students engagement levels as qualities of the physical learning environment that may stimulate successful students outcomes. These attributes that reflects the conducive nature of the physical learning environment is also partly determined by the quality of FM services delivery (Mobach, 2009).

**The Effect of Cleaning Services on Students Physical Learning Environment**

Students spend most time in a day at school; thus, cleanliness of the school environment should remain a priority to school authories since it maximises learning experiences (Odediran et al., 2015; Kärnä, et al., 2013; Kamarazaly et al., 2013). However, spread of diseases due to unclean school environment demotivate teachers and students resulting in productivity issues (Odediran et al., 2015). Therefore, standard and regular cleaning is required since germs and bacteria could be found everywhere in a school. Cleaning as FM service in higher education institutions is provided inhouse, outsourced or mixed; service quality research in higher education is relatively new compared to the business sector. Quality models such as SERVQUAL or SERVPERF scale commonly used in business sector have been adopted and adapted for the education sector (Oladokun and Ajayi, 2018; Cronin and Taylor, 1992; Chua, 2004).

The Effect of Health and Safety on Student's Satisfaction of the Physical Learning Environment

Effective pest management in school environment can serve to prevent pest problems while reducing the risk of pesticide exposure (Nalyanya et. al., 2009). William et al. (2005) carried out a study in North Carolina comparing an Integrated Pest Management (IPM) program with conventional, calendar-based pest control. Results, showed that the two types of treatments were similar in terms of costs and efficacy and demonstrated that an IPM program is suitable alternative to conventional methods of pest control in the school environment. School authorities acknowledge the tendency, regular occurance of incidences causing accidents such as explosions, fires among others. With most school facilities rated as high risk, education providers are under significant pressure to assess their facilities and ensure the health, safety and wellbeing of students and staff. Hassanain, (2006) and Oladokun and Ajayi (2018) developed instruments for the evaluation of educational buildings which included health and safety items. Their studies emphasize the need for school authorities to provide training for facility users, provide proactive procedures and preventive measures such as fire detection and notification systems, fire suppression and extinguishing systems.

**The Effect of Lighting on Students Physical Learning Environment**

Lighting is critical in design, development and operation of buildings especially facilitating the brain's ability to focus. Comparatively, Mott et al., (2012) found students in naturally lit classrooms performance to be better (about 25 percent higher rates) than their peers. Studies have shown that natural lighting has positive influence on leaners interaction, motivation and outcomes (Xue et al., 2014; Earthman, 2004). Gentile et al (2018) also observed that poor

lighting reduces the effectiveness of the brain's power to gather data. Kruger & Zannin (2004) survey comparing luminance in classrooms discovered that during the late afternoon, windows with light shelves produced light lower than prescribed luminance and windows without light shelves created high luminance values throughout the day, which can distract students and teachers as well as increase thermal discomfort. A study into the suitable lighting of classrooms revealed that instructors ideally would want to have control over lighting systems to suit their style of teaching (Realyvásquez-Vargas et al., 2020; Winterbottom & Wilkins, 2009; Hui & Cheng, 2008). The introduction of computer systems to facilitate smart way of controlling and managing illumination levels has being the new drive (Hui & Cheng, 2008).

**The Effect of Noise on Students Physical Learning Environment**

In a global perspective, noise poses danger to human health with negative impact on several human engagements such as studying, interactions among others (WHO, 2011). Ibrahim (2018) studied the effect of noise on students of the faculty of engineering in Mustansiriyah University in Iraq. Out of 438 from all stages, findings were that 39.5%, 46%, 32% and 49% of students suffered from noise in classrooms, laboratories, open spaces and closed spaces(campus), respectively. Effects students experienced were feeling of discomfort, hearing difficulty, raising the voice when speaking, lack of concentration, headache, tinnitus and nausea. Buchari and Matondang (2017) conducted a survey in a State Elementary School, Medan. They concluded that the noise level (70.79 dBA) in the school exceeded the standard set by the Ministry of Environment (55 dBA). The results indicated the noise may cause dizziness, disturbance of effective communication, emotional and uncomfortable feeling. Kopec (2006) also observed that reverberations occurs when there are rebound of sound waves on hard surface causing noise from reflection of sound waves within the classroom. Connolly et al (2015) study revealed that students who required additional learning needs were the ones significantly more affected by poor school acoustics. Comparatively, pupils that were not exposed to nearby noise were more positive about their school acoustics than pupils exposed to external noise sources. It therefore behooves on facility managers of universities to assess and improve the acoustic conditions of educational buildings.

**The Effect of Temperature and Ventilation on Students Physical Learning Environment**

Air quality can affect students' aptitude for learning while inadequate ventilation can make students feel drowsy (Turunen, 2014; Mendell et al., 2013). There is an association between provision of ventilation (outdoor air) and students' health and academic performance. For example, one field study from California found a statistically significant 1.6% reduction in illness absence per each additional liter per second per person (l/s per person) of ventilation provided (Mendell et al., 2013). A study from the Southwestern United States indicated majority of schools had ventilation rates below the American Society of Heating, Refrigerating, and Air-Conditioning recommended minimum of 7.1 l/s per person (ASHRAE, 2004). Also, experimental data from Denmark associated increased ventilation rates in classrooms with improved performance (Wargocki and Wyon, 2007). Low ventilation rates can result in an increased exposure to indoor air pollutants, assumed to be the primary reason for adverse effects on occupant health and performance (Mendell and Heath, 2005). Despite the advantage that natural ventilation poses, stable indoor air environment can not be assured as compared to mechanical means which can easily be controlled and thus most preferable (Yang et al., 2015). Aside inadequate ventilation, some studies have associated

elevated indoor temperatures in schools with impaired performance (Wargocki and Wyon, 2007). Earthman (2002) found that in general people are comfortable at temperatures ranging between 20oC and 24°C with relative humidity at fifty percent (50%). Both measured ventilation rates and elevated temperatures have been associated with students' self-reported stuffiness or poor indoor air quality in classrooms (Turunen et al., 2014).

A summary of the key attributes that represents the various FM services discussed in the review is presented in Table 1.

Table 1: Summary of Indicators for FM Services in Literature

| S/N | Variables | References |
|---|---|---|
| | Noise Control | |
| NOISE1 | Spaces designed to control external noise | Ibrahim (2018); Bucharil and Matondang (2017), |
| NOISE2 | Equipment designed to make minimal noise | Connolly et al (2015) |
| NOISE3 | Spaces designed to reduce vibrating effect of equipment | Ibrahim (2018); Kopec (2006) |
| NOISE4 | Suitable acoustics | Connolly et al (2015) |
| | Lighting | |
| LIGHT1 | Access to natural lighting | Xue et al, (2014); Mott et al., (2012) |
| LIGHT2 | Suitable artificial lighting | Gentile et al. (2018) |
| LIGHT3 | Adequate level of lighting (eg. from projector screens) | Xue et al., (2014); Hui & Cheng, (2008) |
| LIGHT4 | Ability to control the level of lighting | Winterbottom & Wilkins, (2009) |
| | Temperature and Ventilation | |
| TNV1 | Suitable indoor temperature | ANSI/ASHRAE, (2004); Wargocki and Wyon, (2007) |
| TNV2 | Ability to control temperature | Realyvásquez-Vargas et al., (2020), Earthman, (2002) |
| TNV3 | Accessibility to natural air | Mendell and Heath, (2005) |
| TNV4 | Suitable indoor air quality | (Turunen et al., (2014); Mendell et al., (2013) |
| | Health and Safety | |
| HS1 | Effective pest control | William et al (2005) |

| | | |
|---|---|---|
| HS2 | Adequacy of fire extinguishers | Hassanain, (2006) |
| HS3 | Induction of students on fire safety | Oladokun and Ajayi (2018) |
| HS4 | Signs and symbols to caution users | Hassanain, 2006 |
| | Cleaning | |
| CS1 | Standard cleaning services | Cronin and Taylor, (1992) |
| CS2 | Reliable cleaning services | Oladokun and Ajayi (2018); Cronin and Taylor, (1992) |
| CS3 | Timely cleaning services | Cronin and Taylor, (1992) |
| CS4 | Prompt response to cleaning request | Oladokun and Ajayi (2018); Cronin and Taylor, (1992) |
| CS5 | Convenient cleaning operating periods | Cronin and Taylor, (1992) |
| CS6 | Understanding of specific cleaning services by FM staff | Cronin and Taylor, (1992) |
| | Conducive Physical Learning Environment | |
| DV1 | Promote physical and emotional health | Bates (1996) |
| DV2 | Motivate or boost students moral | Asiyai, (2011) |
| DV3 | Support effective engagement levels | Gurzynski-Weiss et. al., (2015) |
| DV4 | Enhances students' concentration | Ibrahim, (2018); Tanner (1999) |
| DV5 | Provides comfortable environment | Ibrahim, (2018); Lowe, (1990); Cash, (1993) |

## Methodology

This study adopts an explanatory sequential mixed methods design which involves a general questionnaire survey followed by telephone interviews on Higher National Diploma (HND) students from six (6) Technical Universities in Ghana (study institutions include Accra, Cape Coast, Koforidua, Kumasi, Sunyani and Takoradi Technical Universities). The questionnaire survey was conducted to determine student's assessment of FM services delivery and its influence on the physical learning environment (which includes classroom, laboratory and workshop). The questionnaire used for the survey was adopted based on the review as presented in Table 1. The survey adopted stratified random sampling technique with HND 2 and 3 students. Students were asked to rank the questionnaire using a likert scale of 1-5 in order of significance from "Strongly Disagree to "Strongly Agree". HND 1 students were exempted as they had no much experimnbec on the university learning environment. Out of the 756 distributed questionnaires, 608 were returned and 582 were considered valid for the statistical analysis. To test the reliability of the questionnaire before conducting the actual survey, a pilot study was conducted and all the constructs indicated reliable with Cronbach's alpha of above 0.7 (Awang, 2014). With regard to data analysis of the survey questionnaire, Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed. It has a number

of advantages, it involves no assumption about distribution of the population and population sample and well controls multi-collinearity (Ringle et al., 2012).

In order to gain a nuanced understanding of the study, further interviews was conducted within the research population in line with the standards of an explanatory sequential mixed methods design. Using telephone interviews1 and purposive sampling, eighteen (18) students representatives of faculties in all the six (6) Technical Universities were interviewed. The choice of student representatives was due to the fact that they represented the students on issues bothering their welfare and were abreast with students complaints and issues on FM services quality in the Technical Universities. Thematic analysis following a six-step procedure by Braun and Clarke (2006) which involves familiarising with the data, searching for the themes, reviewing the themes, defining and naming themes and producing report was used for the qualitative analysis.

**Conceptual Model and Hypothesis**

The principal aim of the study is to assess the effect of facilities management services on the physical learning environment of technical universities in Ghana. The physical learning environment is operationally defined in this study to represent classrooms, laboratories and workshops of technical universities. Five hypotheses were developed according to the FM services that were selected for the study (specifically, cleaning, health and safety, lighting, noise control and, temperature and ventilation) and their impact on the students physical learning environment. The theory of school climate by Gregory, Cornell and Fan (2011) postulates that the relationship between various dynamics creates a school learning environment that has both direct and indirect effect on students' experience in the school, including their academic performance. Physical learning environment such as cleanliness, health and safety, lighting, noise levels, temperature and ventilation create a conducive physical learning environment that facilitates students level of physical and emotional health, motivation, engagement level, concentration and comfortability towards learning.

Based on these assertion, this stuyd hypothesised that:

H1. Cleaning services has a positive significant influence on students satisfaction of the physical learning environment.

H2. Health and safety has a positive significant influence on students satisfaction of the physical learning environment

H3. Lighting standard has a positive significant influence on students satisfaction of the physical learning environment.

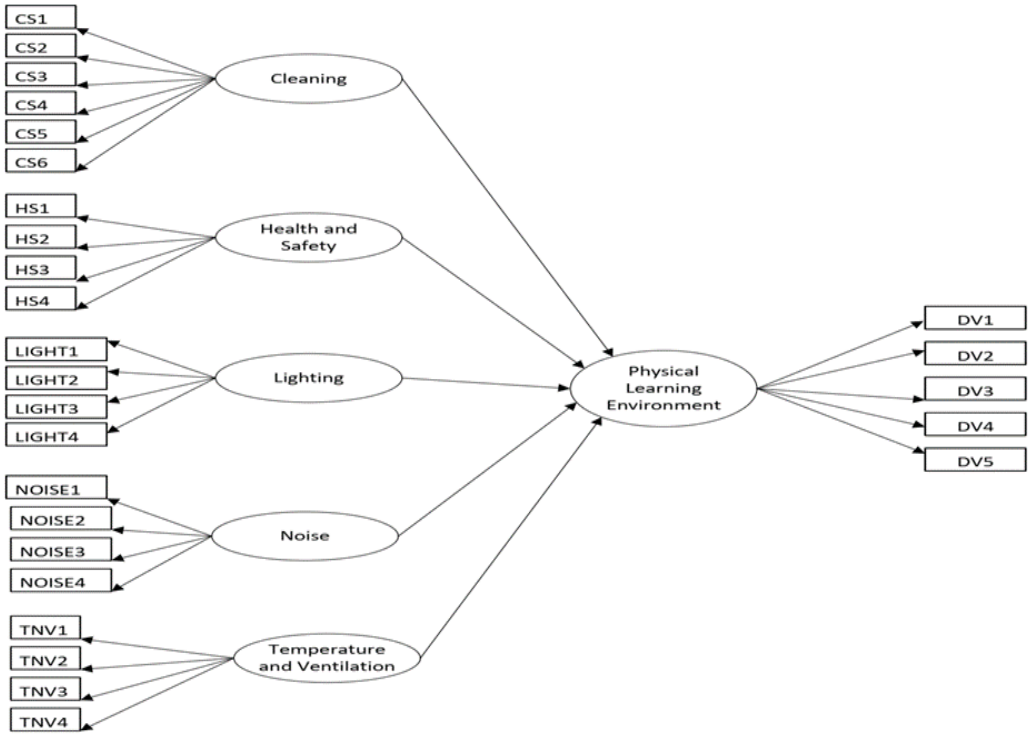
H4. Noise control has a positive significant influence on students satisfaction of the physical learning environment.

H5. Temperature and ventilation has a positive significant influence on students satisfaction of the physical learning environment.

Figure 1 propose a conceptual framework interlinking the relationship between FM service delivery and its impact on students physical learning environment.

Figure 1: Proposed Hypothetical Model

1 Due to covid restrictions as at the time of data collection




## Results and Discussion

### Respondents Profile

Table 2, shows the profile of the respondents sampled for the study by gender, age and the educational institution they represent. Out of the 582 students whose questionnaire were considered valid for the analysis, 410 representing 70.45 percent were males while 172 representing 29.55 percent were females. The dominant age group were those between the ages of 20 – 29 years. Since the sample size was by proportional representation, the sample realised was somehow reflective of the students population in the various institutions. Takoradi Technical University had the highest number of respondents of 161 ( 27.66) while Cape Coast Technical University had the least number of respondents of 22 representing 3.78 percent.

Table 2: Respondents Profile

| Item | Description | Frequency | Percentage |
|---|---|---|---|
| Accra Technical University | A | 121 | 20.79 |
| Cape Coast Technical University | B | 22 | 3.78 |
| Koforidua Technical University | C | 97 | 16.67 |
| Kumasi Technical University | D | 104 | 17.87 |
| Takoradi Technical University | E | 161 | 27.66 |
| Sunyani Technical University | F | 77 | 13.23 |
| Faculties | | | |
| Applied Arts | A,E | 17 | 2.92 |
| Applied Science | A,B,C,D,E,F | 122 | 20.96 |
| Built Environment | A,C,D,E | 32 | 5.50 |
| Business | A,B,C,D,E,F | 216 | 37.11 |
| Creative Arts & Technology | D | 33 | 5.67 |
| Engineering | A,B,C,D,E,F | 132 | 22.68 |
| Entrepreneurship & Enterprise Development | | | |
| Health Science | D | 2 | 0.34 |
| Built Environment and Applied Arts | C,D | 18 | 3.09 |
| | F | 10 | 1.72 |
| Year Group | | | |
| HND 2 | A,B,C,D,E,F | 305 | 52.41 |
| HND 3 | A,B,C,D,E,F | 277 | 47.59 |
| Gender | | | |
| Male | A,B,C,D,E,F | 410 | 70.45 |
| Female | A,B,C,D,E,F | 172 | 29.55 |
| Age | | | |
| Below 20 | A,B,C,D,E | 35 | 6.01 |
| 20 – 29 | A,B,C,D,E,F | 497 | 85.40 |
| 30 – 39 | A,B,C,D,E,F | 34 | 5.84 |
| 40 – 49 | A,C,D,E,F | 16 | 2.75 |

**Data Analysis**

The study employed PLS-SEM as a statistical method to examine the relationship between the dependent and independent variables as suggested by (Hair et al., 2017). The assessment comprised the examination of the measurement model as well as the structural model. The measurement model explores the relationship between the latent variables and observed variables and to provide reliability and validity of the variables used in this study, the structural model examines the direction and strength of the path coefficnets of the constructs that forms the hypothesis of the study.

**Assessment of the Measurement model**

The measurement model test included convergent validity and discriminant validity . Convergent validity involves the assessment of the construct reliability and average variance extracted (AVE). The composite reliability (CR) coefficient of 0.70 or higher is considered to have a good scale reliability (Hair et al., 2010). The results as shown in Table 3, shows the computed composite reliability (CR) of all the latent variables ranges between 0.771 and 0.868. This produces evidence that all the latent variables have good reliability. Additionally, the cronbach alpha was also measured to determine the items reliability. Although Wang and Tai (2003) were of the view that composite reliability is very similar with Cronbach Alpha, Nunnally and Bernstein (1994) holds the view that there is the need to measure the two. Again, the cronbach alpha values ranged between 0.565 and 0.868. All the latent variables were above the 0.50 threshold as recommended by (Huang et al, .2017; Nuanally and Berntein, 1994). For convergent validity, it is required that AVE values be greater than 0.5 to confirm convergent validity, the results in Table 3, shows that AVE and factor loadings were greater than 0.5 hence the result confirm the construct ability to explain over half of the variations of its indicators.

Table 3: Convergent Reliability

| Construct | Items | Loading | Cronbach's Alpha | Composite Reliability | AVE |
|---|---|---|---|---|---|
| Cleaning | | | 0.881 | 0.867 | 0.622 |
| | CS3 | 0.8160 | | | |
| | CS4 | 0.8350 | | | |
| | CS5 | 0.8317 | | | |
| | CS6 | 0.6576 | | | |
| Health and Safety | | | 0.770 | 0.850 | 0.588 |
| | HS1 | 0.7257 | | | |
| | HS2 | 0.8524 | | | |
| | HS3 | 0.7897 | | | |
| | HS4 | 0.6881 | | | |
| Students' satisfaction of PLE | | | | | |
| | DV1 | 0.8945 | | | |
| | DV2 | 0.6124 | | | |
| | DV3 | 0.6585 | | | |
| | DV5 | 0.6365 | | | |
| Lighting | | | 0.565 | 0.771 | 0.535 |
| | LIGHT1 | 0.7778 | | | |
| | LIGHT2 | 0.5587 | | | |
| | LIGHT3 | 0.8287 | | | |
| Noise | | | 0.767 | 0.794 | 0.658 |
| | NOISE1 | 0.8260 | | | |
| | NOISE2 | 0.7857 | | | |
| | NOISE3 | 0.8213 | | | |
| Temp. and Ventilation | | | 0.868 | 0.868 | 0.690 |
| | TNV1 | 0.9148 | | | |
| | TNV2 | 0.8795 | | | |
| | TNV3 | 0.6781 | | | |

**Discriminant Validity**

To confirm discriminant validity, it is required that the diagonal values (square root of AVE) of each latent variable having higher values than its highest correlation of the construct. Thus, the result in Table 4, supports discriminant validity. The result again confirms the absence of multicollinearity (Byrne, 2001).

Table 4: Discriminant Validity (Fornell Larker Criterion)

| Construct | Cleaning | Health and Safety | Physical Learning Environment | Lighting | Noise | Temperature |
|---|---|---|---|---|---|---|
| Cleaning | 0.7886 | | | | | |
| Health and Safety | 0.0552 | 0.7665 | | | | |
| Physical Learning Environment | 0.0529 | -0.1949 | 0.7096 | | | |
| Lighting | -0.0260 | -0.2053 | 0.1488 | 0.7312 | | |
| Noise | 0.0394 | -0.0774 | 0.0738 | 0.2268 | 0.8112 | |
| Temperature | 0.2807 | 0.0996 | 0.0464 | -0.0694 | -0.0253 | 0.8307 |

Additionally, Henseler et al., (2015) is of the view that, to further confirm discriminant validity, the heterotrait-monotrait ratio of correlations (HTMT), which is a multitrait-multi method matrix, ought to be explored to validate the result of the Fornell-Larcker (1981) criterion. According to Kline (2011), to confirm discriminant validity, the HTMT value should not be higher than 0.85. The result as presented in Table 5, indicates that all the values passed the the HTMT 0.85 (Kline, 2011). Consequently, using both the Fornell and Larcker (1981) criterion and the heterotrait-monotrait ratio of correlations (HTMT), the results indicates that discriminant validity was realized.

Table 5: Heterotrait-Monotrait Ratio (HTMT)

| | Cleaning | Health and Safety | Physical Learning Environment | Lighting | Noise | Temperature |
|---|---|---|---|---|---|---|
| Cleaning | | | | | | |
| Health and Safety | 0.0616 | | | | | |
| Physical Learning Environment | 0.0659 | 0.1995 | | | | |
| Lighting | 0.0559 | 0.3220 | 0.1788 | | | |
| Noise | 0.0689 | 0.1278 | 0.0875 | 0.3254 | | |
| Temperature | 0.3384 | 0.2074 | 0.0625 | 0.1139 | 0.0439 | |

Assessment of the Structural Model Analysis and Hypothesis Testing

In order to validate the results of the structural model, we examine the model fitness based on the standardized root mean square residual. According to Hair et al., (2017a), values less than 0.10 or 0.08 indicates an adequate value of covariance residuals. The SRMR of this structural model ranges from 0.0719-0.0968. Thus the difference between the observed correlation and model implied correlation matrix is fit. The results on the assessment of

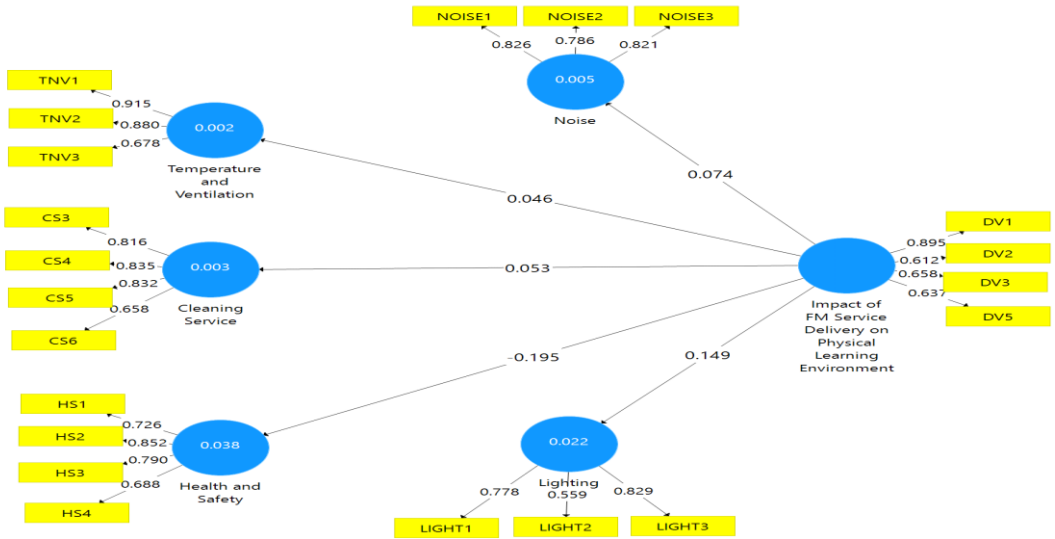
structural model relationships in Bootstrapping method (Ringle et al., 2012) is used to generate results for all the path relationship in the model. Bootstrap sub-samples were created with 5,000 cases to permit the method to assess the model for each subsample (Hair et al., 2014). The constructs were significant at a level of 5%, that is, t-values of 1.95 or higher with p-values of the constructs either 0.01 or lower.

The result revealed inverse significant relationship between Health and Safety and students satisfaction of the Physical Learning Environment (β= -0.195, p>0.05). The result however, revealed positive significant relationship between Lighting and the Physical Learning Environment (β= 0.149, p<0.05) hence Lighting has a positive significant effect on Physical Learning Environment. On the other hand, Noise and Physical Learning Environment were not significantly related (β= 0. 074, p<0.05). Physical Learning Environment was also insignificantly influenced by Cleaning Service (β=0.053, p<0.05) and Temperature and Ventilation (β= 0.046, p<0.05). In all, two (2) hypotheses were supported as shown in Table 6 and figure 2.

Table 6: Summary of the Structural Model Results (T values, path coefficient and P values)

| | Path Coefficient | Standard Deviation (STDEV) | t-values | P Values | Significance Level |
|---|---|---|---|---|---|
| Cleaning Service -> Physical Learning Environment | 0.053 | 0.0745 | 0.7097 | 0.4779 | Not Significant |
| Health and Safety -> Physical Learning Environment | -0.195 | 0.0347 | 5.6198 | 0.0000 | Significant |
| Lighting -> Physical Learning Environment | 0.149 | 0.0481 | 3.0959 | 0.0020 | Significant |
| Noise -> Physical Learning Environment | 0.074 | 0.0558 | 1.3219 | 0.1863 | Not Significant |
| Temperature and Ventilation -> Physical Learning Environment | 0.046 | 0.0654 | 0.7096 | 0.4780 | Not Significant |

Figure 2: Structural Model Showing the Path Coefficient



**Discusion of Results**

The five hypotheses developed for the study are discsussed herein.

Hypothesis 1: Cleaning services has a positive significant influence on students assessment of the physical learning environment.

In the context of this study, the physical learning environment (classrooms, laboratories and workshops) is conceptualized as an educational institution environment that is conducive, emotionally supportive and promote effective teaching and learning. The study result surprisingly does not support the hypothesis that cleaning services of the Technical Universities under study has a positive significant influence on students satisfaction of the physical learning environment. An unclean school's physical learning environment is susceptible to contamination and spread of micro-organisms which has the tendency of impacting negatively on the health and performance of students (Haverinen-Shaughnessy et al., 2015; Mendell et al., 2013).

The second phase of the study using telephone interviews revealed that students dissatisfaction was due to several factors. The following reasons were given by the students in order of priority; inadequate number of cleaners, lack of effective monitoring of cleaning services, delays due to bureaucracy, lack of cleaning materials and equipment, lack of skill of cleaning staff, lack of sanitation policy and lack of commitment by cleaning staff. The responsibility therefore lies on Technical Universities top management and FM department to put the necessary measures in place to provide standard cleaning services that would lead to customer satisfaction and better educational outcomes.

Hypothesis 2: Health and safety have a positive significant influence on students assessment of the physical learning environment

Education providers are required by higher education regulatory bodies to ensure the health and safety of its staff, students and visitors who enter their campuses. That is why it is important to institute effective and proactive health and safety practices in Technical Universities, especially paying more attention to areas assessed as high risk. For this study health and safety is conceptualised as practices that is proactive in preventing and at worst minimises the possible occurance of, fire injury and pest invasion. Students who are respondents of the study are highly impressed with the, level of health and safety practices and thus ranked it very high. Therefore, respondents support the assertion that health and safety of the Technical Universities under study has a positive significant influence on student's satisfaction of the physical learning environment. Unarguably, extant literature have emphazised the significance of healthy and safe physical learning environment to students and likewise the consequences of vice versa. Apparently, healty and safe learning environment have potential of supporting students achieve better academic performance whereas unsafe schools will affect students mental state of mind, motivation and attendance (Kibriya, and Jones, 2021)

Hypothesis 3: Lighting has a positive significant influence on students assessment of the physical learning environment

The effect of lighting on students in physical learning environment cannot be overemphasized. Lighting is vital in the brain's ability to focus and studies have shown that learners in brightly lit environments got higher grades than those in dimly lit classrooms. The

results of the study indicate that respondents are happy with the level of illumination in their classrooms, laboratories and workshops. They support the assertion that lighting systems of the Technical Universities has a positive significant influence on students satisfaction of the physical learning environment. This suggest students can enjoy a feeling of wellbeing, can better focus and yield better learning outcomes (Gentile et al.,2018; Xue et al., 2014; Mott et al., 2012)

Hypothesis 4: Noise control has a positive significant influence on student's assessment of the physical learning environment.
For this study noise is conceptualized as unwelcome sound that could give undesirable effects to a person (student or staff) both physically (hearing loss) and psychologically (frustration and nuisance). Respondents of the study were dissatisfied with the level of noise control on the Technical University campuses and therefore did not support the assertion that it has a positive significant influence on student's satisfaction of the physical learning environment based on existing conditions.

The students revealed during the telephone interviews that poor acoustic condition of the facilities, lack of noise policy, noise from old fans due to poor maintenance culture, lack of notices to caution users on noise making along staircases and verandahs, noise from vehicles across streets and lack of commitment of top management to ensure noise free environment. Unarguably, noisy school environment affects the teaching and learning process (Gogol et al., 2016;). It hinders good verbal communication, places limitation on students ability to improve their talent as noise affect students learning interest in particular learning domains because of lack of concentration (Fryer, 2016; Connolly et al., 2015). The onus lies on the schools authorities to address the concerns of the students.

Hypothesis 5: Temperature and Ventilation has a positive significant influence on students assessment of the physical learning environment
The result of the study does not support the assertion that temperature and ventilation has a positive significant influence on student's satisfaction of the physical learning environment. This implies that they are dissatisfied with the current conditions as far as temperature and ventilation is concerned. According to the students, inadequate ceiling fans and lack of airconditioners, faulty fans not repaired or replaced, delays due to bureaucracy, lack of cross ventilation and inadequate inhouse technicians to service fans and air conditioners were the main reasons stated for their dissatisfaction. Low ventilation rates can result in an increased exposure to indoor air pollutants acknowledged as one of the main reasons for adverse effects on occupant health and performance (Mendell and Heath, 2005). Aside inadequate ventilation, some studies have associated elevated indoor temperatures in schools with impaired performance (Wargocki and Wyon, 2007). Air quality can also affect students aptitude for learning. Inadequate ventilation can make students feel drowsy. Thus, FM managers need to ensure that the temperature and ventilation in the classrooms, workshops and laboratories are ideal for students.

In summary, analysis of the responses given by the students' indicate they are not too happy with FM services delivery in Technical Universities. Interviews with faculty representatives on reasons for dissatisfaction with health and safety, noise control and cleaning services delivery suggest that majority of the reasons reiterated could be traced to

issues relating to FM process implementation in the various institutions. Aligning the reasons for dissatisfaction of FM services delivery with one good generic model of FM process implementation by Atkin and Bjork (2007), FM implementation in Technical Universities is challenged in the processes of strategy formulation, analyses of requirements, developing solutions, implementing solutions and monitoring FM services. This challenge in a way could be attributed to the fact that FM is relatively new in Ghana. There is minimal strategic approach to facilities management, planned corrective and preventive maintenance of facilities has been limited. Analysis of Technical Universities FM requirements does not culminate into developing solutions and implementing those solutions. Monitoring of FM services delivery is also weak and therefore need much attention. Lack of needed attention by top management is also identified as not been given the needed priority. This study result is significant in that it confirms that the student overall assessment of satisfaction with the quality of education delivery is influenced by the quality of the physical learning environment. It also goes to reinforce the assertion that an educational institution's physical environment must be psychologically supportive for the welfare of students (Kärnä, et al., 2013; Kamarazaly et al., 2013; and Odediran et al., 2015). This result may possibly be based on the fact that, although the student who are the respondents of the study may believe that there should be a positive correlation between all the variables under FM service delivery and the physical learning environment, the prevailing conditions at the surveyed Technical Universities do not support this assertion. In order to train middle and higher level manpower to fit industry requirements for Ghana's economic growth, Technical University authorities need to develop interest in FM by giving the necessary support to the FM department in formulating robust strategies aligned to facilitate their strategic business plans with effective implementation and monitoring and evaluation to achieve the required goals.

**Conclusion**

This study sought to determine students assessment of facilities management services delivery on the physical learning environment of technical universities in Ghana. The relationship between the physical learning environment and two of the constructs under educational FM services; that is, Health and Safety, and Lighting were supported. Three constructs namely Noise, Cleaning, Temperature and Ventilation were not supported, meaning students are not satisfied with the level of noise control, cleaning service as well as temperature and ventilation. Based on the survey results, telephone interviews were conducted to find out the reasons for students dissatisfaction. Among the the key reasons given were inadequate number of staff, ineffective monitoring system, poor acoustic conditions of facilities, lack of policies, poor maintenance culture and lack of leadership commitment. Therefore, the educational institutions should consider improving the physical environment especially the noise control, temperature and ventilation as well as the cleaning services. Based on the study finding, it is important that, the surveyed Technical Universities improve their physical learning environment in addition to delivering quality teaching service. The study advance theoretical knowledge in FM which is useful to the developing countries where the concept is emerging. Majority of the studies on learning outcomes have focused on parents, students or teacher characteristics at the expense of the characteristics of the physical learning environment. This study is one of the few that has attempted to investigate the effect of FM services on the physical learning environment from students perspective with the introduction and testing of new dimensions of variables for core facilities services which is valuable to enhance teaching and learning in technical universities in Ghana and by

extension to analogous institutions in developing countries of Africa. Therefore, this study will enrich and contribute to knowledge in educational FM as a whole and that of a developing African country specifically. Given that this research is explaoratory, future research should examine other facilities services. There is also the need to empirically test the model in other public and private universities in the developing context.

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