Available Online at www.e-iph.co.uk
Indexed in Clarivate Analytics WoS, and ScienceOPEN

ASLI QoL 2022

E-B Environment - Behaviour Proceedings Journal

AicQoL2022Penang

https://www.amerabra.org

10th AMER International Conference on Quality of Life

Shangri-la Rasa Sayang, Malaysia, 16-17 Mar 2022

Impact of Physical Learning Environment Towards Students' Satisfaction Level at Taylor's University

Ahmad Ridzwan Othman[1], Nurwafa Alia Ruslan[2], Wahyuni Zahrah[3]

[1] Faculty of Architecture, Planning and Surveying, Universiti Teknologi Mara, 43200 Puncak Alam, Selangor, Malaysia
[2] Arkitektiga Sdn Bhd, 63000 Cyberjaya, Selangor, Malaysia
[3] Department of Architecture, Faculty of Engineering, Universitas Sumatera Utara, Medan 20155, Indonesia

Email of All Authors: dwan_arc7@yahoo.com, wafaliamaster92@gmail.com, Wahyuni.zahra@usu.ac.id
Tel: +60192241631

Abstract
The learning environment needs attention as this space is closely related to students' well-being and learning performance. The ideal learning environment is always changing as innovations in technologies, teaching strategies, and design philosophies require continuous measurement and reassessment. This paper focused on the assessment of the physical learning environment that influences students' satisfaction level at Taylor's University. The result revealed that students' satisfaction levels highly rely on spatial features (room layout and furniture) and ambient features (temperature and acoustics) of the classrooms. The findings and conclusion give an insight concept of the ideal learning spaces of the 21st-century.

Keywords: 21st century classroom; Ideal environment; Learning performance

DOI: https://doi.org/10.21834/ebpj.v7i19.3099

1.0 Introduction

There has been an ongoing pedagogical shift in higher education from a traditional content delivery model to more active models of learning which involved students in interactive roles within the classroom. According to Brown and Long (2006), the emphasis on learning led to the rethinking of the use, design, and learning spaces oriented around the learner. Kuh, et. al, (2011), discovered that the learning environment plays a vital role in higher education aligned with the institutional priorities and goals for student success. Yang, et. al, (2013) stated that classrooms should be configured to provide the best learning environments possible to enhance student learning. Learning environments need attention as this space is closely related to students' well-being and learning performance. Higgins, et. al, (2005) argued that the ideal learning environment is always changing as innovations in technologies, teaching strategies, and design philosophies require continuous measurement and reassessment. To continuously assess the ideal learning environment for ever-changing learning content, an increasing number of experts agreed that it is critically important to consider and treat the student perceptions as important determinants towards improving the learning environment in higher education. Learning spaces are mission-critical for higher education and embody a noteworthy investment in space, technology, time, and furniture. It is critically needed to have an evaluation and assessment to improve space performance, to prove a commonly accepted set of standards for learning spaces and performance of the spaces through certification from third-party. Learning spaces should represent the inclusivity of learners in planned decision-making and future planning to enhance their learning attainment (Harvey & Kenyon, 2013).

eISSN: 2398-4287 © 2022. The Authors. Published for AMER ABRA cE-Bs by e-International Publishing House, Ltd., UK. This is an open access article under the CC BYNC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/). Peer–review under responsibility of AMER (Association of Malaysian Environment-Behaviour Researchers), ABRA (Association of Behavioural Researchers on Asians/Africans/Arabians) and cE-Bs (Centre for Environment-Behaviour Studies), Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA, Malaysia.
DOI: https://doi.org/10.21834/ebpj.v7i19.3099

This paper focused on the assessment of physical classroom attributes influencing students' satisfaction levels of 21st-century learning environments in higher education.

.

1.2 Problem Statement

The ideal learning environment is always changing through time which requires continuous measurement and reassessment by institutions. This leads to a question; "does the provided new-era classroom designed in institutions affect student satisfaction and performance in their learning" and "how do students perceive new-era classroom attributes individually and how are the reported perceptions of different attributes interdependencies among each other?"

1.3 Aim and Objectives

The aim is to identify the physical attributes of new-era classrooms in universities that accommodate the needs and changes of 21st-century education and relations of these classroom attributes on the student perceptions as their ideal learning spaces. The objectives are to investigate both the physical attributes of the classrooms and students' satisfaction levels of those attributes.

1.4 Research Question

In line with the objectives, the research questions are:

- What are the physical attributes found in 21st century designed classrooms?
- How do students perceive ambient, spatial, and technological classroom attributes of 21st century designed classrooms, and what are the interrelationships among perceptions of different attributes towards their satisfaction levels?

1.5 Significance of Research Study

This paper is generally an analysis revolved around the demonstration of influential attributes towards the student perceptions through an analysis of the quality of different classroom factors associated with student perceptions scores. The results of findings and conclusions will give an insight concept of ideal learning spaces and it will be an opportunity for the community of learning space professionals to gather and further develop, promoting and refine the system through time, which is not only improving the learning spaces, but also the community of practice.

2.0 Literature Review

2.1 Learning Environment

The learning environment needs careful attention as this space affects students' comfort and learning performance (Jamaluddin, et. al, 2016). Changes in student perceptions and behaviors on what a conducive learning environment should be have caused students to demand the institutions for changes in the physical environment from the traditional manner to more active models. Perks, et al. (2016) labeled the model as "the active learning classroom", on the belief that these enhancements will at least support the learning outcomes of students.

2.2 21st Century Learning Environment

The learning environment gives an idea of place and space such as campus, classroom, and library. Strange and Banning (2001), suggested that the physical environment is expected to set limits on the pattern behavior act more than others. Learning environments represents the vision of educational philosophy and inclusivity of learners and educators in decision making, as to cultivate accomplishment of learning goals (Harvey, et. al, 2013). Bonwell and Eison (1991) described active learning as a strategy of learning that involves students doing things and thinking about what they are doing throughout the learning process in the classroom. Characteristics of active learning strategies include students who are involved more in listening, sharing ideas or thoughts, and encouraged to engage in critical thinking such as analysis, synthesis, and evaluation rather than memorization.

The classroom's physical attributes related to student learning include the classroom layout, furniture, classroom seating consideration, integration of technological learning tools, lighting, and the placement of windows. These numerous studies illustrate the positive impact of classroom affordances to support classroom practices and enhance active learning in the classroom.

To remain attainable in today's competitive educational market, higher education institutions shall accomplish the changing of learning and pedagogy in the 21st century while continuing their commitment to facilities planning (Harvey, 2013). Learning environments play the main role to stimulate effective learning attainment and skills for 21st-century demands (Pearlman, 2010).

Figure 1: A dynamic teaching space concept for 21st century learning
(Source: Kuuskorpi, M. et. al, 2014)

2.2.1 Spatial Attributes

Spatial attributes include the conditions of spaces that enabled activities and interactions among participants and enabled the relationship between participants and information (Felix, 2011). The integration of learning technologies in 21st-century learning does not necessarily require a big number of physical spaces, but more flexible spaces (Uduku, 2015). Flexibility in space refers to the capability of space to adjust according to the practices of individuals (Monahan, 2000).

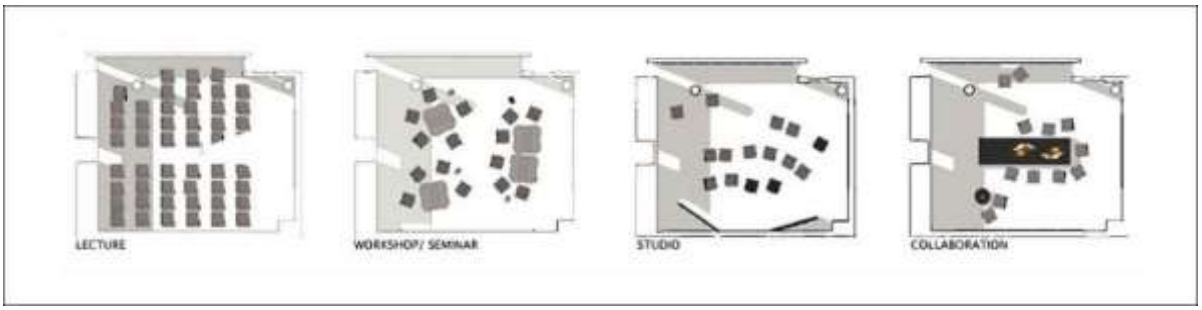

Figure 2: Adaptable classroom spaces for different activities
(Source: Oblinger, D. G., 2006)

Adequate space provided in the classroom allows dynamic interactions between occupants and supports the diversity in teaching and learning methods in the classroom. The 21st-century learning spaces promote student-student interaction, student learning, and student interest in their courses. Hence, to plan the classroom that ensures unobstructed views of participants to see information, to see one another, and to engage the collaborative classroom. It is achieved by planning the seating layout, aisles, display locations with sightline indicated according to specific room spatial layout and different learning strategies.

2.2.2 Ambient Attributes

Oblinger (2005) reported that physical characteristics of learning environments have an impact on learners psychologically. Learning in the classroom is reported to be affected adversely by inadequate light, extreme temperatures, and loud noises. Indoor Environmental Quality (IEQ) is a guideline on enhancing environmental sustainability which applies to learning spaces (Temple, 2007). Environmental sustainability has become a significant feature in university teaching and research to address environmental issues around the world. This rising issue requires architects, designers, and involved parties to give extra attention to reducing energy demands in the buildings by providing adequate natural sunlight and ventilation and minimizing the requirement for cooling and mechanical systems. Environmental Quality (EQ) factors used in the Learning Space Rating System (LSRS) include daylight, views to outdoors, lighting, temperature, acoustic, sightline, and proportions (Felix, 2011).

2.2.3 Technology Attributes

Figure 3: Typical SCALE-UP environment in Ithaca College
(Source: Beichner, R. (2008). The SCALE-UP Project: a student-centered active learning environment for undergraduate programs. An invited white paper for the National Academy of Sciences.)

Technological attributes include hardware and software (Yang, 2013). The arrangement of tables and chairs, projectors and screens, light sources are important features when discussing the specific positioning of technology in the classroom. Lim, et. al, (2012) argued that different classroom types require special technology integration and specific placement in the classroom. For example, the Student-Centered Activities for Enrollment Undergraduate Programs (SCALE-UP) project aims to establish an innovative classroom, equipped with lab equipment and one computer provided for each group cluster, and an instructor station with a projector (Adedokun, et. al, 2017).

2.3 Student Perceptions of Learning Environment

The classroom should be designed in a way that provides the best learning environments to promote student learning. Felix and Brown (2011) developed the Learning Space Performance Rating System and initiated by EDUCAUSE Learning Initiative (ELI) that able to create a platform for comparison through a third party. Generally, student perception can be divided into three categories:

- perception of the psychological environment such as the belongingness and the relationship with classmates,
- perception of the psychological environment such as self-achievement and their motivation,
- perception of the physical environment includes the classroom layout and size, lighting, and technology.

2.3.1 Perceptions of Physical Environments

There are three categories of attributes that are correlated and interdependency to each other to give an impact on students' learning outcomes and behavior. Students evaluate the physical learning environments based on these attributes:

- ambient attributes, including temperature, air quality, artificial and daylight, and acoustics,
- spatial environment attributes such as the layout of the classroom, furniture set in the classroom, visibility, and accessibility,
- integration technology attributes in the classroom including the functional use of high-tech hardware, ease of software use, and net transfer speeds.

3.0 Methodology

The literature review was carried out to understand the fundamental theory behind the 21st Century Classroom Design, the definition, the requirement, and all the contributing factors toward its establishment and performance. Data was collected from journal articles, previous research studies, books, and online articles. A case study was identified to provide an in-depth assessment of a local university about the ongoing pedagogical shift in higher education. Physical attributes including facilities and equipment were assessed through observation, photographing, and physical measurements. An online questionnaire survey was designed and distributed to students to measure the satisfaction level and impact rate of physical attributes in the classroom on their learning performance. The findings were analyzed through a statistical approach by the Likert scales, which is the method of ascribing quantitative value to qualitative data for statistical analysis. This paper takes comprehensive statistical analysis to assess ambient, spatial, and technological attributes through the survey. The results are tabulated in graphs and tables for discussion purposes which leads to conclusions and recommendations.

.

4.0 Finding and Analysis

4.1 Case Study

Figure 4: Taylor's University at the lakeside
(Source: https://portals.taylors.edu.my)

Taylor's University, a private university located in Subang Jaya, Selangor, has been selected as the case study. Opened in 2010 it houses all the tertiary programs ranging from foundation and diploma to degree, postgraduate, and professional programs. To date, the campus occupied over 1200 students. The University has adopted transformative teaching and learning as a bold and imaginative initiative to produce a successful learning outcome. In a new five-year mission, the University has developed and embraced six strategic thrusts to achieve transformational teaching and learning, including: (i) ensuring a conducive and responsive learning environment action plans, such as maintaining the furniture as a learner-friendly environment (ii) enhancing technology action plans by embracing e-learning as an integral teaching and learning strategy for better learning outcomes, module delivery, and assessment aims. With the advent of new pedagogies and adapting technology-based pedagogies, the University provides students with operational smart classrooms facility for a better learning environment and student development.

Analysis of the case study is divided into two parts. Section A involves the assessment of physical attributes of the classroom layout that adapts the 21st Century spatial elements through observation and physical measurement. Section B includes students' perceptions on those related attributes investigated using online questionnaires. Three main physical attributes are used in analyzing both sections, which are spatial attributes, ambient attributes, and technology-related attributes.

4.2 Section A: Physical Attributes of Learning Spaces

There are five types of classroom specifically used for teaching and learning activities; they are Lecture Hall Type 1, Lecture Hall Type 2, Classroom, X-Space, and Computer Lab. Findings for these five classroom types are classified into three physical attributes which are spatial, ambient, and technology-related, documented in the following table.

Table 1: Specification of the 5 Learning Spaces

LEARNING SPACES		Lecture Hall (Type 1)	Lecture Hall (Type 2)	Computer Lab	Classroom	X-Space
Spatial Attributes	Layout	209.25 m^2, wide fan shape theatre, fixed angled seats facing to the front, carpeted	146.25m^2, rectangular theatre with stage. Fixed angle seats facing to the front, carpeted	71.82 m^2. Standard room layout, seats facing to the front, not carpeted	71.82 m^2, rectangular room, seats facing to the front, flexible furniture layout, carpeted	65.94 m^2, table and chairs in 5 clusters, flexible arrangement, not carpeted
	Dimension	13500 mm x 15500 mm	11700 mm x 12500 mm	6650 mm x 10800mm	6650 mm x 10800 mm	7850 mm x 8400 mm
	Capacity	300 pax	200 pax	35 pax	75 pax	30 pax
	Furniture	Fixed tiered seating with tablet arm	Fixed tiered seating with tablet arm	Rectangular table with standard chair, low flexibility	Tablet arm chairs, high flexibility	Circular shaped table with modern mobile chair

Figure 5a: Lecture Hall Type 1

Figure 5b: Lecture Hall Type 2

Figure 5c: Computer Lab

Figure 5d: Classroom

Figure 5e: X-SPACE

Figure 5: Selected five type of learning spaces
(Source: Author)

4.2.1 Spatial Element in Physical Attributes

Lecture Hall 1 and 2 are intensively for large classes, especially for conferences and events. The basic classroom has uniform rows of tablets, a whiteboard, and two TV monitors, one at the front and another at the back of the class. The furniture setting enables easy collaboration among students. The room layout and furniture setting promote effective teaching and learning practice and are suitable for group projects and presentations. X-Space provides lecturers and students with an opportunity to experiment with radical flexibility in space emerged with high-end technologies. There are five clusters, each with a table and six (6) chairs arranged to face each other that accommodate small group discussions. The Computer Lab contains 35 individual numbers of high-end computers and individual rectangle tables with standard chairs, a digital whiteboard, and a projector.

4.2.2 Spatial Element in Ambient Attributes

The ambient attributes observed from the selected classrooms are lighting, window opening, and ventilation. Lecture Hall 1 and Lecture Hall 2 are integrated with the AV technology to control windows shades as the room allows total control of the environment from the instructor's station. The hall's openings allow natural light and a view of the adjacent green area, especially at the Lecture Hall Type 1. The Classroom, the Computer Lab, and the X-Space are generally designed with adequate numbers of windows and openings to bring natural daylight. LED light is widely used in the university as a sustainable design measure supporting the "green building" campaign.

4.2.3 Spatial Element in Technology Attributes

The technology attributes observed from the selected five learning spaces are the adaptation of Information Technology hardware and software in the rooms. Generally, the two lecture halls feature dual LCD projectors for computers and video sources, tethered microphones, document camera at the front instructor's station equipped with a push-button control panel. Meanwhile, the classroom, the Lab, and X-Space are equipped with an AV system box containing auxiliary audio/video input jacks, tethered microphone, document camera, push-button control panel, and a computer. Additionally, in the X-Space classroom, BYOD (Bring Your Own Device) principle is embraced. The facilitator's console table and student's tables are equipped with VGA and HDMI input to accommodate various devices from students. The university is wireless throughout the entire campus.

4.3 Section B: Students' Perception on Classroom Physical Attributes

The study was carried out to determine the satisfaction and impact rate of the students' learning performance at Taylors University based on the classroom physical attributes. The questionnaire was distributed online and answered by 35 respondents and their responses are analyzed through statistical means and presented using visual statistics. More than two-thirds of them are in their 2nd year (37.1%) and 4th year (28.6%). It comprised 45.7% undergraduates and 54.3% postgraduates, mostly from Architecture programs (68.6%). Most of the respondents are bright students with a CGPA of 3.00 -3.49 (62.9%). Half of the respondents prefer to sit in the middle of the class (51.4%), whilst 40% prefer to sit at the back, and only 8.6% prefer to sit in the front section.

Table 2: Respondents' Demographic (35 numbers)

Respondents' Demographic				
Gender	13 Males (40 %)	22 Females (60 %)		
Age	18 - 25 years (40 %)	26 – 30 years (51.4 %)	31 – 35 years (1.4 %)	36 years and above (1.2 %)

4.3.1 Spatial Attributes

Table 3: Respondents' Satisfaction with Spatial Attributes

Spatial Attribute	Very Poor (%)	Poor (%)	Moderate (%)	Good (%)	Very Good (%)
Furniture Setting	8.6	28.6	25.7	34.3	2.8
Seating Arrangement	11.4	5.7	34.3	37.1	11.5
Room Layout	2.9	25.7	34.3	28.6	8.5

More than half of the respondents (62.8%) were satisfied with the furniture set in the respective room. Whilst most of the respondents (82.9%) were satisfied with the seating arrangement. With regards to the room layout, 28.6% of the respondents expressed their dissatisfaction.

Figure 6: Factors affecting respondents' rating on Furniture Setting

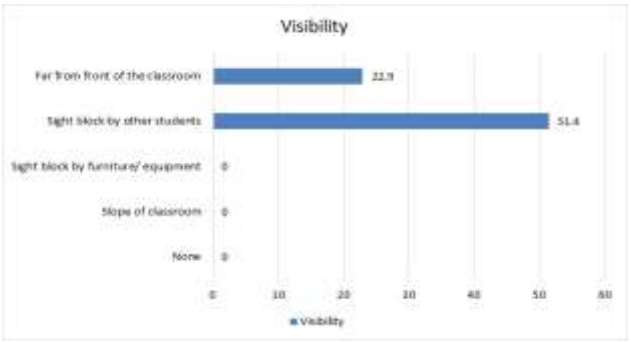

Figure 7: Factors affecting respondents' rating on Visibility (Furniture Setting)

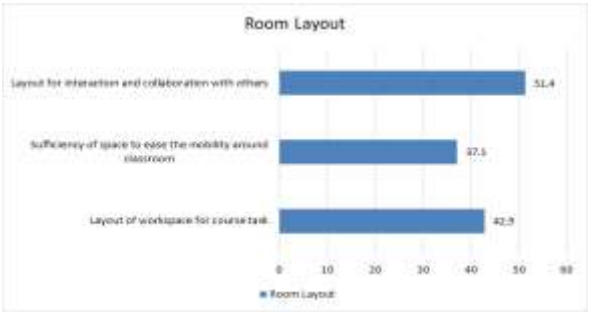

Figure 8: Factors affecting respondents' rating on Room Layout

Three main aspects evaluated by respondents based on their perceptions of the presence of learning spaces are visibility, furniture, and room layout. The majority of the respondents (51.4%) claimed that their line of sight was blocked by students in front, whilst 22.9% claimed that the front screen was a bit too far for a good vision. On the furniture aspect, respondents have almost equal votes for the three (3) choices given. About 44.1% of respondents were satisfied with the comfort of the furniture, 41.2% happy with the mobility of furniture, and 35.3% were satisfied with the number of tables and chairs provided.

Respondents have mixed feelings about the room layout. The majority (51.4%) were happy with the interaction and collaboration that the room layout offered. About 42.9% claimed that the room layout was suitable for them to carry out their daily tasks. Meanwhile, 37.1% of the respondents were satisfied with the mobility that the classroom layout offered.

4.3.2 Ambient Attribute

Table 4: Respondents' Satisfaction with Ambient Attributes

Ambient Attribute	Very Poor (%)	Poor (%)	Moderate (%)	Good (%)	Very Good (%)
Temperature	0	0	57.1	37.1	0
Air Quality	0	20	45.7	31.4	2.9
Natural Lighting	0	11.4	44.1	0	0
Artificial Lighting	0	5.7	31.4	51.4	11.5
Acoustics	2.9	22.9	25.7	42.9	5.6

Ambient attributes considered in this study include temperature, air quality, natural lighting, artificial lighting, and acoustic. Generally, most respondents were satisfied with all the ambient attributes in the learning spaces. All respondents are happy with the indoor temperature. The indoor air quality and the acoustic within the spaces posed slight dissatisfaction among the respondents who voted 20% and 25.8% respectively. Only a small percentage of the respondents claimed that the quality of natural lighting (11.4%) and artificial lighting (5.7%) are on the poor side and need improvement.

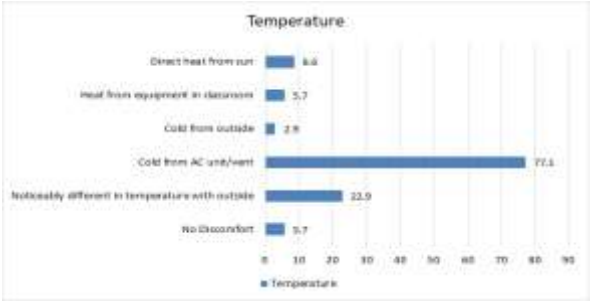

Figure 9: Factors affecting respondents' rating on Temperature

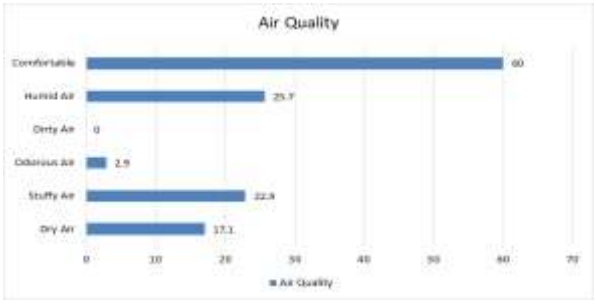

Figure 10: Factors affecting respondents' rating on Air Quality

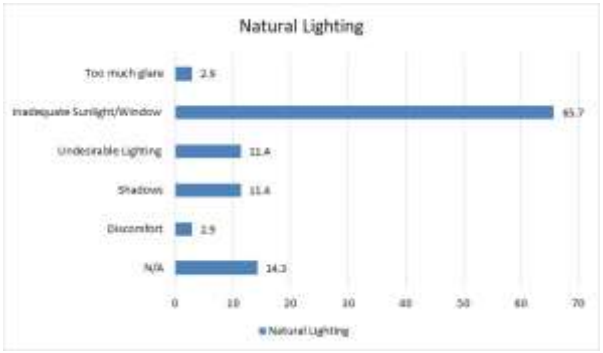

Figure 11: Factors affecting respondents' rating on Natural Lighting

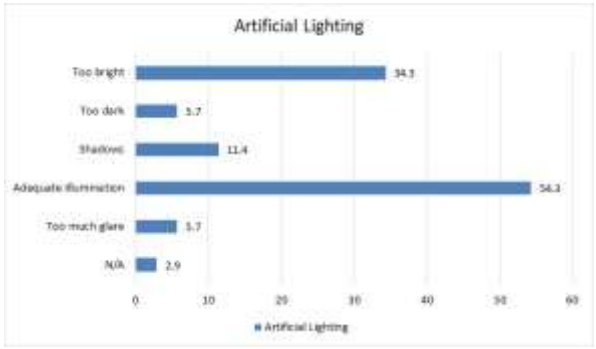

Figure 12: Factors affecting respondents' rating on Artificial Lighting

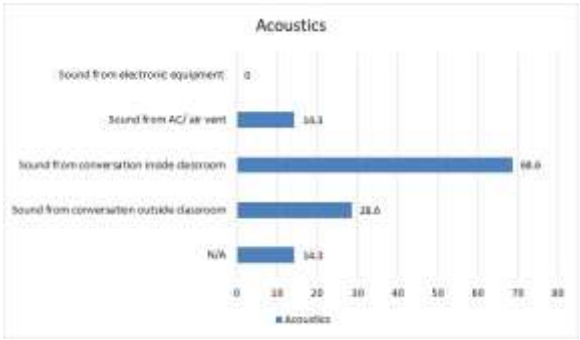

Figure 13: Factors affecting respondents' rating on Acoustics

4.3.3 Technology-related Attribute

Table 5: Respondents' Satisfaction with Technology-related Attributes

Attribute	Very Poor (%)	Poor (%)	Moderate (%)	Good (%)	Very Good (%)
Technology-related	14.3	20	37.1	22.9	5.7

Technology attributes studied in this paper include the integration of hardware and software. It can be seen in Table 5 that most of the respondents considered technology in the classrooms as acceptable and satisfactory (65.7%), and 34.3% have their reasons for dissatisfaction.

4.3.4 Impact Rate of Classroom Physical Attributes on Students' Performance

Table 6: Students' Impact Rate on Spatial Attributes

Spatial Attribute	No Impact (%)	Less Impact (%)	Moderate (%)	Good Impact (%)	Large Impact (%)
Furniture Setting	2.9	8.6	14.3	57.1	17.1
Seating Arrangement	0	20	14.3	40	25.7
Room Layout	0	11.4	17.2	31.4	40

From Table 6, it can be seen that students' learning impact rate with regards to spatial attributes highly relies on furniture set in the classroom. More than half of the respondents (57.1%) voted furniture set in the classroom provides a "good impact" on their learning. Meanwhile, for the seating arrangement attribute, most respondents (40%) voted good impact on their learning, and 25.7% of them voted for a "large impact". On room layout, the highest votes (40%) are "large impact" followed by 31.4% of students voted "good impact" to their learning.

Furniture setting has a high percentage of good impact reasonably because of well-designed ergonomically and functionality of chairs and workstations to helps their learning in the classroom. Room layout has a high percentage of "large impact" reasonably because of well-defined space arrangement that offers greater interaction with other students. To relate with the students' perception scores in earlier data studied, it shows the positive relations between the satisfaction scores and impacts score as students are satisfied with the room layout, hence, providing a reasonably good impact on their learning.

Table 7: Students' Impact Rate with Ambient Attributes

Ambient Attribute	No Impact (%)	Less Impact (%)	Moderate (%)	Good Impact (%)	Large Impact (%)
Temperature	0	0	22.9	54.3	22.8
Air Quality	0	2.9	37.1	34.3	25.7
Natural Lighting	5.7	17.1	31.4	28.6	17.1
Artificial Lighting	0	5.7	34.3	45.7	14.3
Acoustics	0	2.9	22.9	48.6	25.7

From Table 7, it can be seen that for temperature attribute gives a "good impact" on their learning with a percentage of 54.3%, followed by 22.9% of students voted a "moderate impact" on their learning. For air quality, mostly voted for "moderate impact" with a percentage of 37.1%, followed by 34.3% voted for "good impact". Students considered natural lighting attributes as "moderate impact" on their learning, with a percentage of 31.4% votes. It seems that students preferred artificial lighting which is more reliable and predictable compared to natural lighting, with 45.7% voted as a "good impact". Lastly, 48.6% of students voted that the acoustic attribute gave them a "good impact" on their learning through the efficient sound system.

Table 8: Students' Impact Rate with Technology-related Attributes

Attribute	No Impact (%)	Less Impact (%)	Moderate (%)	Good Impact (%)	Large Impact (%)
Technology-related	0	8.6	22.9	40	28.6

From Table 8, it can be seen that for a technology-related attribute in the classrooms, most students rated that the technologies have a "good impact" on their learning with a percentage of 40 %, followed by 28.6% of students voted for "large impact". Hence, to relate with previous data studied on satisfaction scores of students, they are moderately satisfied with the adaptation of technology in the classroom and indicated that technology gives a "good impact" on their overall performance.

.

5.0 Conclusion

The study has achieved the aim to assess the physical attributes of new-era classrooms in the university that accommodate the needs and changes of 21st-century learners. The literature review helps in defining important terminology such as learning environment and what the 21st-century classroom should have. The case study at Taylor's University has succeeded to provide detailed information on selected learning spaces with regards to physical attributes, namely spatial, ambient and technology. The first objective was achieved, which confirmed that the five learning spaces studied have the quality of the 21st Century classroom design. Data from the Questionnaire distributed proved and revealed that the majority of the students were satisfied with all the learning spaces in the university, hence, meeting the second objective. In conclusion, the students are aware of the benefits of new classroom inventions that aligned with the contemporary pedagogical approaches to support collaborative learning activities in classrooms. It increases interactivity between students-to-students and students-to-instructors.

6.0 Recommendation

Further analysis could be envisaged using analytical software packages for cumulative impacts of each attribute and the interdependencies among perceptions of all the studied attributes. Few of the attributes may be correlated to each other and influence the perceptions scores. It is also recommended to include other influencing factors such as students' hours in the classroom and the session (morning, afternoon, or night).

Acknowledgement

The authors would like to thank UiTM for the infrastructure supports given.

References

Adedokun, O. A., Parker, L. C., Henke, J. N., & Burgess, W. D. (2017). Student Perceptions of a 21st Century Learning Space. Journal of Learning Spaces, 6(1).

Bonwell, C. C., & Eison, J. A. (1991). Active Learning: Creating Excitement in the Classroom. 1991 ASHE-ERIC Higher Education Reports. ERIC

Brown, M. & Long, P. (2006). Trends in learning space design, Learning spaces, researchgate.net
Clearinghouse on Higher Education, The George Washington University, One Dupont Circle, Suite 630, Washington, DC 20036-1183.

Cornell, P. (2002). - The impact of changes in teaching and learning on furniture and the learning environment
New directions for teaching and learning, Wiley Online Library

Felix, E., & Brown, M. (2011). The case for a learning space performance rating system. Journal of Learning Spaces, 1(1), n1.

Han, A. N. Y., Leong, L. C., & Nair, P. K. (2014). X-Space Model: Taylor's University's Collaborative Classroom Design and Process. Procedia-Social and Behavioral Sciences, 123, 272-279.

Harvey, E. J., & Kenyon, M. C. (2013). Classroom seating considerations for 21st century students and faculty. Journal of Learning Spaces, 2(1).

Hashim, Y. (2014). 21 Century Education: Are we heading towards the right direction of improving teaching and learning as needed by educational transformation programme.

Higgins, S., Hall, E., Wall, K., Woolner, P., & McCaughey, C. (2005). The impact of school environments: A literature review. London: Design Council.

Jamaludin, N.M., Mahyuddin, N. & Akashah, F.W. (2016). Assessment of Indoor Environmental Quality (IEQ): Students Well-Being in University Classroom with the Application of Landscaping, MATEC Web Conf., Volume 66, 2016

Kuh, G.D., Kinzie, J., Schuh, J.H. & Whitt, E.J. (2016). The 4th International Building Control Conference (IBCC 2016). John Wiley & Sons, 7 Jan 2011 - Education - 416 pages

Kuuskorpi, M. (2014). Perspectives from Finland–towards new learning environments. Finnish National Board of Education: Publications, 1.

Lim , F.V., O'Halloran, K.L. & Podlasov, A. (2011). Spatial pedagogy: mapping meanings in the use of classroom space. Articles, Pages 235-251 | Received 10 Mar 2011, Accepted 25 Jan 2012, Published online: 22 May 2012 https://doi.org/10.1080/0305764X.2012.676629
.
Monahan, T. (2000). Built pedagogies & technology practices: Designing for participatory learning. In Participatory Design Conference, Palo Alto, CA.

Levy, Fran; Murnane, F. & Richard J. (2004). Education and the Changing Job Market. Educational Leadership, v62 n2 p80 Oct 2004Journal Articles; Opinion Papers; Reports - Descriptive

Oblinger, D. G. (2006). Learning Spaces. Educause. Retrieved May 2007, from www.educause.edu/learning spaces

Oblinger, D. (2005). Leading the transition from classrooms to learning spaces. Educause quarterly, 28(1), 14-18.

Pearlman, B. (2010). Designing new learning environments to support 21st century skills. 21st century skills: Rethinking how students learn, 116-147

Perks, T., Orr, D., & Alomari, E. (2016). Classroom Re-Design to Facilitate Student Learning: A Case Study of Changes to a University Classroom. Journal of the Scholarship of Teaching and Learning, 16(1), 53-68.

Strange, C.C. & Banning, J.H. – (2001). Educating by Design: Creating Campus Learning Environments That Work. The Jossey-Bass Higher and Adult Education Series.

Temple, P. (2007). Learning spaces for the 21st century: A review of the literature.

MGM Thariq, M.G.M. (2010). - Investigation of the interaction effects of sitting comfort and discomfort factors, dl.lib.uom.lk

Uduku, O. (2015). Spaces for 21st-century learning. Chapter in the Book. Routledge Handbook of International Education and Development Edition1st Edition, First Published2015, ImprintRoutledge, Pages14, eBook ISBN978131579700

Yang, Z., Becerik-Gerber, B., & Mino, L. (2013). A study on student perceptions of higher education classrooms: Impact of classroom attributes on student satisfaction and performance. Building and Environment, 70, 171-188.