P-ISSN: 2776-7329, E-ISSN: 2776-7310
Proceedings
5th Vocational Education International Conference
Semarang, 13 July 2023

Post Occupancy Evaluation of Study Facilities, Faculty of Engineering, State University of Gorontalo

Indriati Martha Patuti*, Rahmani Kadarningsih, M. Yusuh Tuloli, Ulin Naini, Iswanto Mane

Universitas Negeri Gorontalo
**Corresponding author. Email: indri.m.patuti@ung.ac.id*

ABSTRACT
This study was conducted to identify and evaluate study room facilities at the Faculty of Engineering, State University of Gorontalo. The classrooms considered include the capacity of 19 classrooms (specifically C2 and C3 buildings), the condition of walls, finishing, ceilings, floors, doors, windows, furniture, lighting, and ventilation. The method used in this study is a quantitative experimental method with a research approach using field experiments, which is based on the results of observations, documentation, and measurements in the field. The evaluation was carried out after occupancy for two years. Based on the identification and assessment, it was found that the size of the classrooms met the standards according to the capacity of the study room. The walls and ceiling found a little damage that must be repaired immediately. The condition of the floors, doors, and windows is quite good. Dimensions of tables, chairs, and whiteboards are standard. Several chairs (bolts lose) on the writing table are damaged, so repairs are needed. Natural lighting meets the standard of>250 lux in eight classrooms, while other classrooms do not meet the standard (<250 lux), so artificial light needs to be added.

Keywords: Post-Occupancy Evaluation, Study Facilities, Performance of Faculty of Engineering, State University of Gorontalo.

1. INTRODUCTION

Campus facilities are vital in supporting tertiary teaching and learning activities. The standards for the needs of campus facilities and infrastructure have been determined through a rule or guideline stipulated by the National Education Standards Agency. Therefore, in planning campus facilities and infrastructure, such as the design of lecture buildings and their facilities, paying attention to the applicable provisions is mandatory.

The Faculty of Engineering, State University of Gorontalo's lecture building is a new building occupied since 2020. This building is equipped with facilities and infrastructure. After entering the third year through this lecture, it is necessary to carry out a post-occupational evaluation (POE). Post-occupancy evaluation was carried out to assess the condition of existing learning facilities at the Faculty of Engineering, State University of Gorontalo.

Post-occupancy evaluation (POE) is a method for assessing the performance of adequate and systematic building utilization. POE is regular and can be implemented at different occupancy levels, ranging from 3-6 months to 3-5 years. POE is closely related to interior design because there is a high level of interaction between interior spaces and the people who live and work in them [1]. Previous researchers have carried out many studies on POE. Wibowo et al. (2018) conducted a post-occupational evaluation on campus X to be a reference for new building designs. The results of the analysis based on the collaboration of qualitative and quantitative methods stated that class performance was well perceived by students, while aspects of cleanliness, filling elements, noise, and air temperature still needed to be improved [1]. A post-occupational evaluation conducted by Syafriani et al. (2015) at SLB YPAC Manado showed that the performance of the YPAC Manado SLB preparation class based on behavioral aspects was obtained from area attributes, accessibility, privacy, socialization, sensory stimulation, and comfort [2].

Based on the results of an assessment of the performance of noise engineering in the preparation class for SLB YPAC Manado, it was concluded that noise performance had not met the needs of educational activities for children with special needs based on noise design standards. This is in sync with the use of mentoring classes for the mentally disabled, but not by deaf education classes, so it is necessary to make improvements, plans, and make budget plans to help schools. Then it can become a standard guide for the design of school buildings for children with special needs [3]. Sunandar etc. (2019) identified and measured the utilization level of school facilities in three categories: buildings/rooms, electronic devices, and library books. The study results show that the level of utilization of school assets is not optimal in the three schools. The story of utilizing school buildings is not optimal because the study schedule is only from 07.00 to 13.00. Schools can use the facility for more than 6 hours. Asset utilization is not optimal because teachers rarely use the available electronic tools. This shows that teachers in these schools use conventional learning processes. Borrowing books from the library shows students' reading levels are still low [4]. Agyekum etc. (2016) evaluated the management, functionality, and environmental friendliness of two graduate student residences located on the Kwame Nkrumah University of Science and Technology (KNUST) campus. Based on an analysis of the Relative Satisfaction Index (RSI), a survey of 70 postgraduate students living in the two dormitories showed high satisfaction with the bedroom, T.V. room, bathroom, kitchen, meeting room, lobby, and other support services. Feedback from residents, namely suggesting future renovations and effective dormitory management, increases residents' comfort [5]. Post-occupancy evaluation studies were also conducted by Dewantari (2020) [6], Lail and Kusuma (2015) [7], Pratama and Sudarwanto (2020) [8], and Laudi, etc. (2017)) [9]. Each class at University X in Surabaya has more or less the same problems regarding room design (floors, ceilings, walls), elements of room conditioning (lighting, ventilation, acoustics, circulation, and layout), and elements of room-filling (furniture), so proposed alternative solutions to choose suitable materials for classrooms [9].

2. LITERATURE REVIEW

Post Occupancy Evaluation (POE) is a process of evaluating a building systematically and thoroughly after the building has been completed and used for some time. POE focuses on the user and the user's needs so that it can provide knowledge about the consequences of past design decisions and the results of building performance. This knowledge becomes a reasonable basis for creating better buildings in the future [10].

2.1. Lecture Halls

Based on University Room and Infrastructure Standards, Undergraduate Programs, and Professional Training (2011), lecture halls are spaces where face-to-face teaching occurs. These learning activities include lectures, discussions, tutorials, and seminars. The maximum capacity of the lecture hall is 25 students; the standard room requirement is 2 m^2/student. In addition, the classroom circulation is placed at least 60 cm to facilitate movement. Each campus has at least one large lecture hall that can accommodate 80 students and has a common area of 1.5-2 m^2 per student. Classrooms must have facilities and infrastructure, including lecturer chairs, student chairs, LCD projectors, and blackboards [11].

2.2. Space-Shaping Elements

Ching (1996) in Laudi, etc. (2017) explained that the walls of classrooms and lecture halls must have a minimum sound transmission class (STC) of 50. All walls must extend to the top floor or roof of the building and may not stop at the shelter. This reduces the occurrence of call forwarding and also increases security. The last choice that is often used as a wall covering material and the properties of the material is paint. Paint lasts only 1-2 years because paint color changes quickly and cannot withstand heat and humidity. Air Conditioner (A.C.) resistance is quite good. This paint material is most often used as a wall coating in all rooms because, apart from being low maintenance and affordable, it is also available in several different colors that can be applied as desired. Classrooms usually use neutral colors like white. Pile (2003) in Laudi etc. (2017) state that the floor is the main space that supports interior and furniture functions in the room, so the floor structure must be such that it can withstand loads safely, and the surface must be strong enough to withstand use. Alternative flooring materials and features include ceramics and carpets, which act as acoustic elements and reduce sound transmission. The ceiling is the most critical room element, ensuring good efficient distribution and adequate volume throughout the room. The roof should act as a useful mirror, reflecting sound downward and mixing it with direct sound. The color of the ceiling must be neutral, for example, white. It should be noted that colored tops can reduce light levels and change the mood of a room. The material commonly used is plasterboard. In addition, sound-dampening materials can also be used if special acoustic treatment is required [9].

2.3. Space-Filling Elements

According to Ernst Neufert (1996), seven general criteria must be met to achieve comfort at the table: 1). shoes must be flat on the floor; 2). there is space between the back of the knee and the front of the seat; 3). at the

front of the seat cushion, there is no pressure between the thigh and the seat cushion; 4). there should be enough room to move between the underside of the table and your thighs; 5). table height is approximately equal to the elbow when the arm is vertical; 6). slightly curved back; 7). between the backrest and the seat cushion, there is space for the coccyx [12].

The dimensions of lecture chairs are adjusted to measurements of the proportion and size of the human body [12]. Neyland et al. (2019) explained that chair sizes based on the Kansei Engineering method are as follows: 1). backrest height of 66 cm is obtained from the shoulder height by adding 0.33 cm; 2). the width of the back is 50 cm from the width of the shoulders, with a margin of movement of 0.97 cm; 3). the distance from the thigh to the table is 24 cm at the elbow height of the chair; 5). chair leg height of 49 cm, measured from knee height; 6). seat width of 40 cm calculated from the hips' width; 7). armrest length of 54 cm obtained from the size of the forearm, chair seat length 48 cm; 8) the arm reaches to table 75 cm, and 9) the distance from the back of the chair to the table is 32 cm obtained from the thickness of the body with an addition of 0.25 cm. The seat and back of the chair are filled with foam while the outer material is polyester, and the shape of the table is square [13].

2.4. Space-Conditioning Elements

Based on SNI 03-6197 (2000), the minimum light level in the classroom cannot be lower than 250 lux [14]. In addition to saving energy consumption, it can be generated by reducing installed power by choosing lamps with higher efficiency in converting electricity into light and avoiding using low-power lamps. It is recommended to use fluorescent lamps and other gas discharge lamps [15], [16]. During the day, natural light must meet the following requirements: 1) natural light must be used as best as possible; 2) when using natural light, direct solar radiation entering the building must be minimized. Skylights should face direct sunlight; 3) Natural lighting in buildings must comply with the provisions of SNI 03-2396-1991 Procedures for Designing Natural Daylighting for Houses and Buildings [14].

Natural ventilation shall consist of permanent openings, windows, doors, or other devices which can be opened, the whole part of which shall be at least 5% of the room's floor area requiring ventilation. One factor that influences the criteria for the thermal comfort of people is dry air temperature. The thermal comfort area for the tropics can be divided into 1) comfortable excellent, between an effective temperature of 20.5^{o}C ~ 22.8^{o}C; 2) optimal comfort, between effective temperatures of 22.8^{o}C ~ 25.8^{o}C; 3). comfortably warm, between effective temperatures of 25.8^{o}C ~ 27.1^{o}C [17].

The minimum whiteboard size is 120 cm x 240 cm, and is hung from a hanging point 2 m high from the floor. Placed in the middle of the front of the class, the distance from the bottom is 80-85 cm. Meanwhile, the ideal angle of the eye in the first line does not exceed 30^{o} [18].

3. RESEARCH METHOD

This research was conducted in the Faculty of Engineering lecture building (C2 and C3), the State University of Gorontalo, located in Bone Bolango Regency, Gorontalo Province. The method used in this study is a quantitative experimental method with a research approach using field experiments, which is based on the results of observations, documentation, and measurements in the field. Measure lecture room lighting using a light meter application (lux meter android). The measurement implementation procedure is based on SNI 16-7062 (2004) dan SNI 03-2396 (2001) [19] [20]. The secondary data was obtained indirectly from scientific articles, books, applicable guidelines/standards, and other references related to research.

The data analysis used is quantitative descriptive analysis. The study results of data collected through measurements in the field are compared with applicable standards/rules. Suppose it is not by applicable regulations/standards. In that case, it is necessary to make suggestions for improvement as the output of an evaluation of learning facilities at the Faculty of Engineering, State University of Gorontalo.

4. RESULT AND DISCUSSION

4.1. Classroom Needs Analysis

The Gorontalo State University Faculty of Engineering Building is a campus that has only been occupied since early 2020, with a total of 18 classrooms, consisting of 2 micro-teaching classrooms in building C2 floor 1 (MTC 1.1 and MTC 1.2) and 17 classrooms in the C3 which is spread over the 1st, 2nd, and 3rd floors. On the 3rd floor, there are two theater classrooms (RK 3.16 and RK 3.17), as shown in Figure 1. The large lecture hall combines two small rooms without partition walls: R.K. 1.1-RK 1.3 and R.K. 1.2-RK 1.4 (Figure 2). Classroom dividing wall material R.K. 2.6-RK 2.8; R.K. 2.7-RK 2.9; R.K. 3.12-RK 3.14; and R.K. 3.13-RK 3.15 is a folding door made of double multiplex wood which can be opened/closed so that each can be combined into one large class. In summary, an analysis of classroom needs is shown in Table 1. Based on BSNP (2011), for small classrooms, the maximum capacity of a lecture hall is 25 students with a common room area of 2 m^2/student. For large classrooms, the maximum capacity of lecture halls is 80 students with a common room area of 1.5 m2/student [11]. All classrooms in the Faculty of Engineering meet the requirements, with an area of >50 m^2 for small and >120 m^2 for large classrooms.

Figure 1 Theatre Lecture Room (R.K 3.16/R.K 3.17)

Figure 2 The Large Lecture Room (R.K 1.2-R.K 1.4)

Table 1. Class Room Condition

Room Name	Dimension (m')	Area, A (m^2)	Need Per Student (m^2)	Capacity (Person)	Standart Capacity (Person)	Remarks
1	2	3	4	5= 3/4	6	7=5>6
MTC 1.1	8.20 x 6.30	51.66	2	25.83	25	Suitable
MTC 1.2	8.20 x 6.30	51.66	2	25.83	25	Suitable
RK 1.1	8.20 x 16.25	133.25	1.5	88.83	80	Suitable
RK 1.3						
RK 1.2	8.20 x 16.25	133.25	1.5	88.83	80	Suitable
RK 1.4						
RK 1.5	8.20 x 8.00	65.60	2	32.80	25	Suitable
RK 2.6	8.20 x 8.00	65.60	2	32.80	25	Suitable
RK 2.8	8.20 x 8.00	65.60	2	32.80	25	Suitable
RK 2.7	8.20 x 8.00	65.60	2	32.80	25	Suitable
RK 2.9	8.20 x 8.00	65.60	2	32.80	25	Suitable
RK 2.10	8.20 x 8.00	65.60	2	32.80	25	Suitable
RK 2.11	8.20 x 8.00	65.60	2	32.80	25	Suitable
RK 3.12	8.20 x 8.00	65.60	2	32.80	25	Suitable
RK 3.14	8.20 x 8.00	65.60	2	32.80	25	Suitable
RK 3.13	8.20 x 8.00	65.60	2	32.80	25	Suitable
RK 3.15	8.20 x 8.00	65.60	2	32.80	25	Suitable
RK 3.16	8.20 x 8.00	65.60	2	32.80	25	Suitable
RK 3.17	8.20 x 8.00	65.60	2	32.80	25	Suitable

Each lecture room has the following facilities: 1 unit of LCD projector and 1 unit of blackboard, furniture for lecturers' desks/chairs, and student chairs according to the room's capacity. Only four classrooms have permanently installed LCD projectors. R.K. 1.5, R.K. 2.10, and R.K. 2.11 are equipped with student study tables (Figure 3). For information and communication technology facilities, it is equipped with two campus internet servers and an institutional email account.

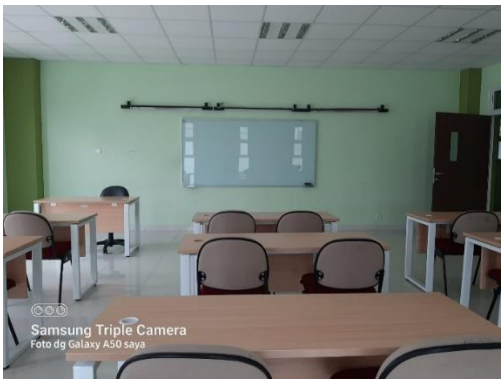

Figure 3 Lecture Room With Desk Facilities (R.K. 1.5)

4.2 Evaluation of Spatial Forming and Transition Elements

In general, the results of direct observation showed that the condition of the walls and finishing was good. However, some cracks were due to hard impacts, as in the column where gypsum material was used as a column cover. The condition of the walls, finishing, floors, and ceilings of the Faculty of Engineering lecture halls are shown in Table 2.

Table 2. Space-Shaping and Transision Elements Condition

Room Name	Wall and Finishing Condition	Plafond and Finishing Condition	Floor Condition	Door / Window Conditon
1	2	3	4	5
MTC 1.1	Good	Good	Good	Good
MTC 1.2	Good	Good	Good	Good
RK 1.1	Good	Good	Good	Good
RK 1.3	Good	Good	Good	Good
RK 1.2	Good	Good	Good	Good
RK 1.4	Good	Good	Good	Good
RK 1.5	Good	Good	Good	Good
RK 2.6	Good	Good	Good	Good
RK 2.8	Good	Good	Good	Good
RK 2.7	Good	Good	Good	Good
RK 2.9	Good	Good	Good	Good
RK 2.10	Good	Good	Good	Good
RK 2.11	Good	Good	Good	Good
RK 3.12	Good	Good	Good	Good
RK 3.14	Good	Good	Good	Good
RK 3.13	Good	Good	Good	Good
RK 3.15	Good	Good	Good	Good
RK 3.16	Good	Good	Good	Good
RK 3.17	Good	Good	Good	Good

The wall paint in the classrooms was quite good, but some small parts looked dirty, so it needed repainting. Besides that, in one class, one part of the ceiling covering was missing. The condition of the doors and windows is generally good, but there are some broken window locks for the windows, so they need to be repaired. The door used is 2.00 m x 1.20 m in good quality with double multiplex wood and has a glass slit to make it easier to see activities outside the room. The conditions of the forming elements and space transitions are shown in Table 2, while the analysis of the area of the openings is described in Table 3. The analysis results show that the opening area in all classrooms does not meet the applicable standards, which is 20% of the room area, so it is not enough to obtain optimal natural lighting.

4.3 Evaluation of Space-Filling Elements

The dimensions and condition of chairs, tables, and blackboards are generally by applicable standards, but some chairs have been damaged (loose bolts) on the writing table. For this reason, improvements need to be made so that the number of seats matches the capacity of the classroom.

4.4 Evaluation of Space Conditioning Elements

The results of light measurements in each classroom in the morning and afternoon are shown in Table 4. Light measurements and artificial light were carried out under natural and natural light conditions. The highest measurement rement value is influenced by the position of the window and the sun at the time of measurement. As the result of calculating the need for natural light, the space that meets the need for natural light is the lecture hall: MTC 1.1; MTC 1.2; RK 2.6; RK 2.7; RK 2.10; RK 2.11; RK 3.12; and RK 3.13.

The position of this classroom is in the front and back order, where the ratio of the window area to the classroom area is larger so that if multiplied by the skylight of 1,500 lux, the light requirement is greater than 250 lux, and no additional artificial light is needed. Based on the observations of classroom ventilation, the average temperature of the room is 24.7^{o} C, so it is stated that conditions are optimally comfortable (standard temperature is 22.8^{o} C- 25.8^{o}C).

5. CONCLUSIONS

Based on the research results, the following conclusions are obtained:

1. Classroom capacity meets applicable standards, with a lecture hall area of 52.66 m^2 and 65.60 m^2 (A>50 m2 for a maximum capacity of 25 students) and a large lecture hall area of 133.25 m^2 (A>120 m2 for a maximum capacity of maximum 80 students).
2. The condition of walls, finishing, floors, ceilings, doors, and windows is generally good, but a few are damaged, so they must be repaired.
3. Dimensions of tables, chairs, and whiteboards are standard. Several chairs (bolts lose) on the writing table are damaged, so repairs are needed.
4. Natural lighting meets the standard of>250 lux in eight classrooms, while other classrooms do not meet the standard (<250 lux), so artificial light needs to be added. In contrast, the ventilation of the classrooms is categorized as optimal comfort with an average temperature of 24.7^{o} C.

Table 3. Room Opening Area

Room Name	Floor Area, A (m^2)	Standar Minimum Aperture (20%xA)	Number of Windows				Total of Room Opening Area (m^2)	Remarks
			Stationary Window (40 x 60)cm	Awning Window (40 x 60)cm	Awning Window (120 x 40) cm	Stationary Window (20 x 50) cm		
1	2	3	4	5	6	7	8	9=8≥3
MTC 1.1	51.66	10.33	20	20	1	-	10.80	Unsuitable
MTC 1.2	51.66	10.33	20	20	1	-	10.80	Unsuitable
RK 1.1	133.25	26.65	30	50	1	1	20.36	Unsuitable
RK 1.3					1	1		
RK 1.2	133.25	26.65	30	50	1	1	20.36	Unsuitable
RK 1.4					1	1		
RK 1.5	65.60	13.12	12	22	1	1	8.74	Unsuitable
RK 2.6	65.60	13.12	18	28	1	1	11.62	Unsuitable
RK 2.8	65.60	13.12	12	22	1	1	8.74	Unsuitable
RK 2.7	65.60	13.12	18	28	1	1	11.62	Unsuitable
RK 2.9	65.60	13.12	12	22	1	1	8.74	Unsuitable
RK 2.10	65.60	13.12	18	28	1	1	11.62	Unsuitable
RK 2.11	65.60	13.12	18	28	1	1	11.62	Unsuitable
RK 3.12	65.60	13.12	18	28	1	1	11.62	Unsuitable
RK 3.14	65.60	13.12	12	22	1	1	8.74	Unsuitable
RK 3.13	65.60	13.12	18	28	1	1	11.62	Unsuitable
RK 3.15	65.60	13.12	12	22	1	1	8.74	Unsuitable
RK 3.16	65.60	13.12	0	24	1	1	6.34	Unsuitable
RK 3.17	65.60	13.12	0	24	1	1	6.34	Unsuitable

Table 4. Measurement and Calculation of Class Room Light

Room Name	Room Area (m^2)	Opening Area(m^2)	Morning		Afternoon		Light Needs	Remarks (≥250 Lux)
			Natural (Lux)	Natural and Artificial (Lux)	Natural (Lux)	Natural and Artificial (Lux)	3/2x1500 Lux	
1	2	3	4	5	8	9	8	9
MTC 1.1	51.66	10.80	745.20	897.40	720.10	868.30	292.68	Suitable
MTC 1.2	51.66	10.80	748.30	899.60	726.80	873.40	292.68	Suitable
RK 1.1	133.25	20.36	191.60	400.00	144.40	251.60	229.19	Unsuitable
RK 1.3			193.20	293.00	119.40	247.40		
RK 1.2	133.25	20.36	726.20	878.60	208.20	516.00	229.19	Unsuitable
RK 1.4			589.40	777.40	176.20	436.20		
RK 1.5	65.60	8.74	105.40	234.00	182.00	286.60	199.85	Unsuitable
RK 2.6	65.60	11.62	506.80	520.00	237.80	379.80	265.70	Suitable
RK 2.8	65.60	8.74	325.20	544.60	172.20	309.80	199.85	Unsuitable
RK 2.7	65.60	11.62	198.00	324.60	142.40	272.60	265.70	Suitable
RK 2.9	65.60	8.74	179.60	252.40	209.80	263.00	199.85	Unsuitable
RK 2.10	65.60	11.62	645.80	909.40	302.80	572.40	265.70	Suitable
RK 2.11	65.60	11.62	188.20	349.60	124.80	323.20	265.70	Suitable
RK 3.12	65.60	11.62	297.00	666.60	291.00	483.60	265.70	Suitable
RK 3.14	65.60	8.74	400.80	527.40	309.20	484.60	199.85	Unsuitable
RK 3.13	65.60	11.62	151.00	276.60	199.40	869.40	265.70	Suitable
RK 3.15	65.60	8.74	181.40	313.20	258.20	373.40	199.85	Unsuitable
RK 3.16	65.60	6.34	131.00	201.60	104.40	225.80	144.97	Unsuitable
RK 3.17	65.60	6.34	106.80	268.00	117.20	249.40	144.97	Unsuitable

REFERENCES

[1] M. Wibowo, P. E. Tedjokoesoemo and R. Soebagio, "Evaluasi Performa Ruang Kuliah di Kampus X," *Humaniora*, vol. 15, no. 1, pp. 15-22, 2018.

[2] Syafriyani, Sangkertadi and J. O. Waani, "Evaluasi Purna Huni (EPH): Aspek Perilaku Ruang dalam SLB YPAC Manado," *Media Matrasain*, vol. 12, no. 3, pp. 1-13, 2015.

[3] Syafriyani and N. Mutmainnah, "Evaluasi Purna Huni (EPH) Aspek Teknik Kebisingan pada Ruang Kelas Persiapan SLB YPAC Manado," *Jurnal Teknik*, vol. 20, no. 2, pp. 118-131, 2022.

[4] A. Sunandar, D. D. N. Benti, B. Sumarsono and Burhanuddin, "Post Occupancy Evaluation of School Assets for Effective Schooling," *International Journal of Innovation, Creativity, and Change*, vol. V, no. 4, pp. 150-163, 2019.

[5] K. Agyekum, J. Ayarkwa, and P. Amoah, "Post Occupancy Evaluation of Postgraduate Stendent's Hostel Facilities and Services," *Journal of Building Performance*, vol. VII, no. 1, pp. 97-104, 2016.

[6] S. E. Dewantari, "Evaluasi Pasca Huni Perpustakaan Departemen AArsitektur Fakultas Teknik," *Imaji*, vol. IX, no. 3, pp. 231-240, 2020.

[7] J. Lalil and A. R. Kusuma, "Evaluasi Pasca Huni Bangunan SDN 01 Sentono," *Jurnal Inovasi dan Kewirausahaan*, vol. IV, no. 1, pp. 46-49, 2015.

[8] M. I. P. Pratama and B. Sudarwanto, "Evaluasi Pasca Huni Studio Program Studi Arsitektur Fakultas Teknik Universitas Diponegoro," *Imaji*, vol. IX, no. 4, pp. 411-420, 2020.

[9] D. Laudi, M. Wibowo and S. M. Frans, "Kajian Evaluasi Pasca Huni Desain Interior Ruang Kelas Program Studi Desain Interior Universitas X Surabaya," *Jurnal Intra*, vol. V, no. 2, pp. 631-640, 2017.

[10] W. F. Preiser, "The Evolution of Post Occupancy Evaluation: Toward Building Performance and Universal Design Evaluation," in *Learning From Our Buildings: A State of the Practice Summary of Post Occupancy Evaluation*, Washington DC, National Academy Press, 2001, pp. 9-22.

[11] Badan Standar Nasional Pendidikan, Rancangan Standar Sarana dan Prasarana Pendidikan Tinggi Program Pascasarjana dan Profesi, Jakarta: BSNP, 2011.

[12] E. Neufert, Data Arsitektur, 33 ed., vol. I, Jakarta: Erlangga, 1996.

[13] J. S. Neyland, J. Mende and M. E. Rembet, "Pengembangan Kursi Kuliah dengan Metode Kansei Engineering dan Pendekatan Anthropometri di Fakultas Teknik Unsrat Manado," *Jurnal Tekno Mesin*, vol. V, no. 2, pp. 76-87, 2019.

[14] Badan Standardisasi Nasional, SNI 03-6197: Konservasi Energi pada Sistem Pencahayaan, Jakarta: Badan Standardisasi Nasional, 2000.

[15] E. P. Dewi, "Optimasi Sistem Pencahayaan Ruang Kuliah Terkait Usaha Konservasi Energi," vol. IX, no. 2, pp. 80-88, 2011.

[16] S. H. J. Tongkukut and As'ari, "Analisis Tingkat Pencahayaan Ruang Kuliah dengan Memanfaatkan Pencahayaan Alami dan Pencahayaan Buatan," *Jurnal Mipa Unsrat Online*, vol. V, no. 2, pp. 108-112, 2016.

[17] Badan Standardisasi Nasional, SNI 03-6572: Tata Cara Perancangan Sistem Ventilasi dan Pengkondisian Udara pada Bangunan Gedung, Jakarta: Badan Standardisasi Nasional, 2001.

[18] P. F. Aminah, "Kajian Antropometri dan Penataan Ruang pada Ruang Perkuliahan Fakultas Teknik Universitas Negeri Semarang," Universitas Negeri Semarang, Semarang, 2013.

[19] Badan Standardisasi Nasional, SNI 16-7062: Pengukuran Intensitas Penerangan di Tempat Kerja, Jakarta: Badan Standardisasi Nasional, 2004.

[20] Badan Standadisasi Nasional, SNI 03-2396-2001: Tata Cara Perancangan Sistem Pencahayaan Alami pada Bangunan Gedung, Jakarta: Badan Standadisasi Nasional, 2001.