ISSN 2809-6339

VISUAL COMFORT AND USER PERCEPTION CLASSROOM LECTURES IN BUILDINGS EDUCATION

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ABSTRACT

Visual perception or human response to visual conditions that are accessed by their visual senses, is strongly influenced by light because light is what allows us to access visual information. For that, it is important for us to be able to meet the need for light appropriately and in accordance with the needs of a space, both indoor and outdoor. Visual quality in the lecture classroom can have positive and negative impacts depending on the user and the factors that shape the visual quality in the lecture room. The purpose of this study was to measure and evaluate the visual comfort of natural lighting in classrooms that are directly related to the building envelope and to assess the perception of space users. Research Methods with a combination of qualitative and quantitative methods by distributing data from questionnaires and measurements in the form of tables, diagrams and graphs. The sample location of the study is an educational building in Makassar City. Data analysis was carried out using the comparative method by comparing the results of the questionnaire and measuring light intensity with correlation statistics and Likert scale. The results show that the forming factors of visual quality such as not using artificial light because it has an impact on shadows and heat in the room, the use of projector (LCD) media in the teaching and learning process, the atmosphere/impression of the visual quality of natural light, and the area and spatial arrangement are the dominant factors in providing comfortable perception for space users. Then the results of the measurement of light intensity show the average level of room illumination intensity of 300 lux. This is in accordance with the comfortable perception of the use of space in the classroom and the SNI standard for lecture rooms of 250 lux.

Keywords: Visual Comfort, Natural Light, Perception, Classroom, Education.

1) INTRODUCTION

Visual Comfort Is a condition where humans feel not disturbed by the surrounding conditions that are received by the sense of sight. Generally related to the intensity of light in the vicinity. To get good visual comfort, it can be done by taking direct measurements and also through the perception of space users. Lecture room according to the National Education Standards Agency (2011) lecture room is a room where learning activities take place on a regular basis.

Each room requires a different intensity of lighting according to the use and activities in the room (Chairul G. Irianto, 2006). According to the Indonesian National Standard SNI 03-

6575-2001, the minimum recommended lighting intensity for lecture halls is 250 lux. To achieve the desired visual comfort, there are 2 factors that need to be considered, namely the lighting system and the arrangement of the room. The lighting system is related to the intensity of light used such as natural lighting and artificial lighting, visual quality is obtained from the quantity of light, the distribution of light illumination, light glare, shadows, climate, and the and the reflection of the colour of light in the room, while the arrangement of the room is related to the use of furniture, the material used, the area of the room, and the height of the ceiling.

Visual quality in the lecture classroom can have positive and negative impacts depending on the user and the factors that shape the visual quality in the lecture room (Fisher, Godwin, and Seltman (2014). According to Aminah (2013) Effective learning can start from a room climate that can create exciting learning atmosphere. For this reason, it is necessary to pay attention to the arrangement and arrangement of space and its contents. The classroom environment needs to be well organized in order to allow active interaction between students and lecturers. There are several principles that need to be considered in managing the physical classroom environment, including visibility, accessibility, space flexibility, beauty, and comfort. With regard to comfort, the visual quality is an important thing to pay attention to. Visual quality in lecture classrooms can be measured through user perception parameters as a determinant of achieving ideal visual quality in lecture rooms.

According to Suwarno, 2009 perception is the process of making judgments or building an impression about various things in the field based on one's senses. Perception of a place is often related to the visual which is influenced by the impression captured by the sense of sight. Therefore, the visual quality of an ideal space becomes an important factor in building the impression of a space.

Building B, Faculty of Engineering, University of Bosowa is a building used for lectures, occupying the 2nd, 3rd, and 5th floors. The orientation of the building's facade faces North and South. The results of the observations identified that on the flat surface of the facade with a vertical strip of glass that causes glare in the lecture room, while on the south side there is light shadowing during the day which also causes glare in the room. Based on this, the purpose of this study is how the visual quality of the lecture room is based on the perception of the user (student) and the level of light intensity that is comfortable for classroom users.

2) METHODS

The research was conducted using a combination method (mix method). Mix-method research is a method that combines qualitative and quantitative approaches in terms of methodology (such as in the data collection stage), and mixed model studies combine the two approaches in all stages of the research process (Abbas, 2010).our methods tell readers how you conducted your study. It includes information about your informants (respondents), population, sample, methods, and equipment. Typically, methods are written in past tense, and they use a lot of passive voice. Meanwhile, according to Creswell (2014: 5) mix-methods is a research approach that combines or associates qualitative and quantitative forms. The qualitative analysis was based on the respondent's questionnaire information related to the perception of visual comfort in the natural lighting of the lecture classroom, while the quantitative was based on the results of measuring the intensity of natural light. This research is exploratory (Groat & Wang, 2002) to reveal various information about the perception of each individual user of the lecture room regarding the visual quality that they think is ideal. The location of the object of research is Building B, Faculty of Engineering, University of Bosowa, which consists of 3 floors, with the function as lecture classrooms. Classroom locations consist of large, medium, and small classrooms.

Data collection was carried out by distributing questionnaires to students who carried out teaching and learning activities in the classroom and also through distributing questionnaires

through the google form format, then measuring the intensity of light simultaneously. Measurements were carried out using a lux meter. Measurements and questionnaires were taken for 3 (three) days in a row with a time span of morning (09-00 – 12.00), afternoon (13.00 – 14.00), and afternoon (15.00-17.00). Measurement of light intensity and taking questionnaires without using artificial lighting and curtains in the classroom. The total sample of respondents was 90 respondents who were divided based on the characteristics of gender, age, and generation.

The questions on the questionnaire use open-ended questions to get various data. The questions were divided into three groups, namely the respondent's personal data, a description of the ideal visual quality in the lecture room, and the impact of the ideal visual quality on the continuity of teaching and learning activities in the lecture room. Data analysis using comparative analysis method. This comparative method is used to compare the results of the questionnaire information and the results of measuring light intensity. The results of the questionnaire from the respondents were processed using a Likert scale by distributing the results of the questionnaire in the form of tables, diagrams, and graphs, then the analysis of the measurement results was compared with the minimum standard of SNI for classrooms (250 lux) which was distributed in the form of a table of measurement results.

The results of this analysis are used to determine the closeness between the forming factors of visual quality based on the perception of the level of comfort, standards and the results of measuring visual quality to the users of the lecture room.

3) RESULTS

The object of this research is in building B floors 2, 3, and 4 which is the lecture area of the Faculty of Engineering, University of Bosowa. There are 10 lecture rooms on each floor which are divided into 4 large lecture halls that accommodate around 25 - 50 students and 6 medium lecture halls which accommodate about 20-35 students. This lecture room is in the orientation of the North – South of the sun's path. Measurement samples and questionnaires taken in large lecture halls were taken from 2 (two) rooms each on each floor on the North and South sides so that a class sample of 6 (six) room units was obtained.

Figure 1 Facade of the building and measurement area

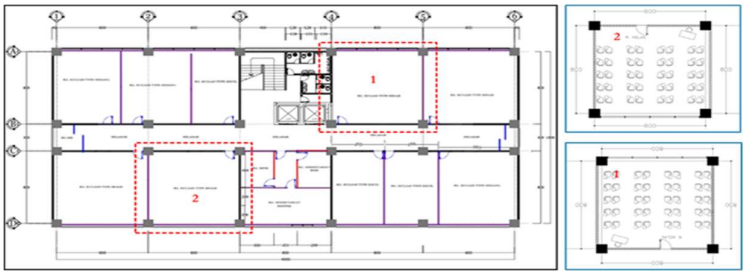

Figure 2 Floor plan measurements

Figure 3. Research measuring tools

Based on the results of the questionnaires distributed with a total of 90 students, the respondents were divided into 3 characteristics, namely gender, age, and class, there were 53% male respondents and 47% female respondents. The age of the respondents varies with the range between 19 - 22 years and the class of respondents starts from the class of 2018 - 2021. Dominated by the Class of 2020 (35%). The categories of visual forming factors given to respondents using space are shown in the following table.

Table 1 Factors Forming Visual Quality

No	Questionnaire of the factors forming visual quality
1	Lecture room area and arrangement
2	Current seat layout
3	Natural lighting quality
4	When the light is turned off, Natural lighting visual quality.
5	Atmosphere/impression visual quality
6	Projector (LCD) screen visual display quality
7	Use of curtains or wallpaper
8	In general, the natural lighting atmosphere of the lecture classroom

Source. Author's analysis, 2021

To find out how the responses of classroom users based on indicators of the results of questionnaires and interviews were analysis using a Likert scale through descriptive statistical analysis. Likert scale is used to measure attitudes, opinions, and perceptions of a person or group of people about social phenomena. With a Likert scale, the variables to be measured are translated into variable indicators. Then the indicator is used as a starting point for compiling instrument items which can be in the form of statements or questions. The answer to each instrument item using a Likert scale has a level from very positive to very negative which can be in the form of sentences and for quantitative purposes, the answer can be scored.

a. Very Comfortable/Very Good (VC) was given a score of 5.

b. Comfortable/Good (C) scored 4

c. Fairly Comfortable / Fairly Good (CE) was given a score of 3.

d. Less Comfortable/Not Good (LC) is given a score of 2

e. Uncomfortable/Not good (UC) was given a score of 1.

Table 2 Classification of Mentions Average Score and Percent

No	Classification	Average Score	Average Percent
1	Very Comfortable/Very Good (VC)	4,10 – 5,00	81,00 – 100,00 %
2	Comfortable/Good (C)	3,10 – 4,00	61,00 – 80,00 %
3	Comfortable Enough/Good Enough (CE)	2,10 – 3,00	41,00 – 60,00 %
4	Less Comfortable/Not Good (LC)	1,10 – 2,00	21,00 – 40,00 %
5	Uncomfortable/Not Good (UC)	0,10 – 1,00	0 – 21,00 %

When responding to questions from the questionnaire, respondents gave their level of agreement to the questions and gave answers in accordance with the factors forming the visual quality so that an analysis of the perception of visual comfort was obtained based on the average score and percentage.

Perception of Space User's Visual Comfort

The content analysis stage is a question based on respondents' answers regarding the visual quality that makes users feel comfortable in the lecture room as shown in the following graphic image.

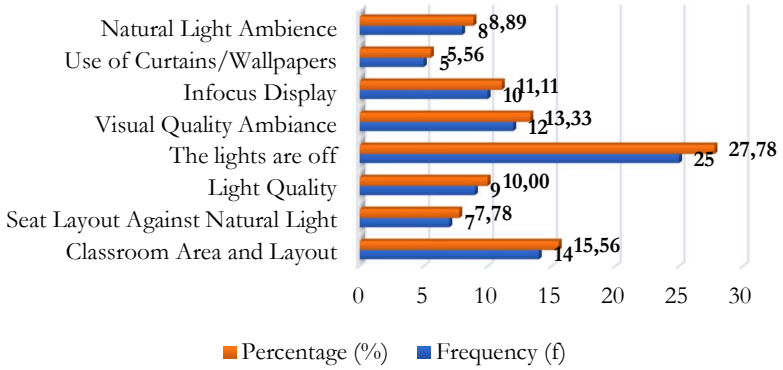

Figure 4 Graph of visual quality forming factors

The first stage of the frequency distribution analysis was carried out on 90 student respondents to answer the factors that form the ideal visual quality for users in the lecture room. From the results of the distribution analysis found the dominant factor can be seen in Figure 4. It is known that the category that has the highest frequency is visual quality when the lights are turned off based on a questionnaire of 90 respondents surveyed, 25 student respondents (27.78%) think that when the lights are turned off in lectures, the visual quality of natural lighting is very comfortable. This is based on that when the lights are turned on, the atmosphere in the room becomes hot and then spacious and the arrangement of the room is 14 (15.56%) followed by the visual atmosphere of the classroom by 12 (13.33%), the visual quality when LCD is turned on. by 10 (11.11%), and the quality of natural lighting by 9 respondents (10%).

The least chosen factor is the arrangement of room chairs by 7 (7.78%) followed by the use of curtains by 5 (5.56%). The second stage of the frequency distribution analysis was carried out on 90 student respondents to answer each of the factors forming the ideal visual quality for users in the lecture room. This analysis then produced 8 distribution charts which were analysis using a Likert scale as shown in Figure 5 below.

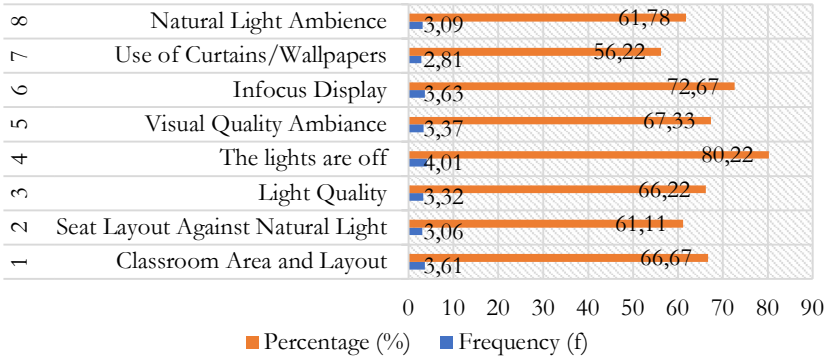

Figure 5 Likert scale graph of factors forming visual quality

Based on the Likert scale analysis on the visual comfort response of classroom users, it was found that it was slightly different, although not significant from the first stage of the frequency distribution analysis, this can be seen in the forming factors of visual quality based on a sequence of questions with a wide and obedient location of furniture explaining the placement of teaching media so that it is easily accessible, neat and symmetrical seating arrangements, as well as modern and adequate room facilities.

Of these three things, respondents tend to not pay attention to the size of the room and the layout of the furniture. Based on the weight value and the frequency of the Likert scale assessment, the average value and percentage with the qualification "comfortable" is 3.10 - 4.00 (61.00 - 80.00%) the quality of visual comfort is based on the perception of class room users.

Perception of Visual Comfort Based on Lecture Time

The next stage is to analysis the perception of space users based on the lecture time. Lectures start at 08.30 – 17.00 WITA. This lecture time has been determined based on the university's rules for operational activities on campus. Based on the results of the questionnaire analysis based on the ideal lecture time for visual comfort, it can be seen in Figure 6 below.

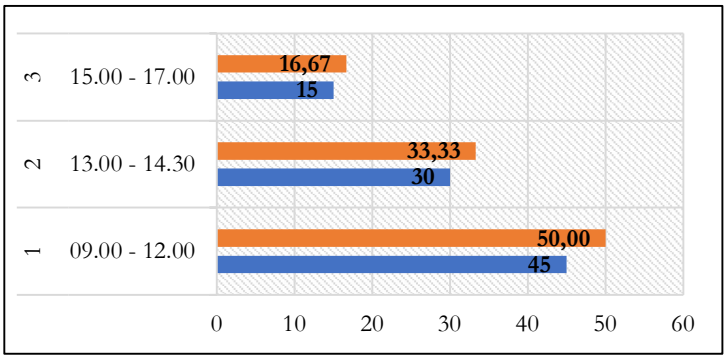

Figure 6 Lecture time graph for visual quality

Based on the graph above, the tendency of students to feel comfortable carrying out teaching and learning activities in the morning (08.30 – 12.00 hours).

Measurement of Light Intensity Classroom Classrooms 2, 3, and 4

The large lecture hall has a size of 8 m x 8 m, a ceiling height of 2.75 cm, and is oriented to the north and south. This room has a natural light source on the building envelope (side lighting) by using a building facade in the form of a vertical strip of massive glass, so that natural light can enter the classroom without a facade barrier, and sunscreen, only on the massive glass wall affixed with 60% glass stickers as a barrier. reduce light entering the classroom.

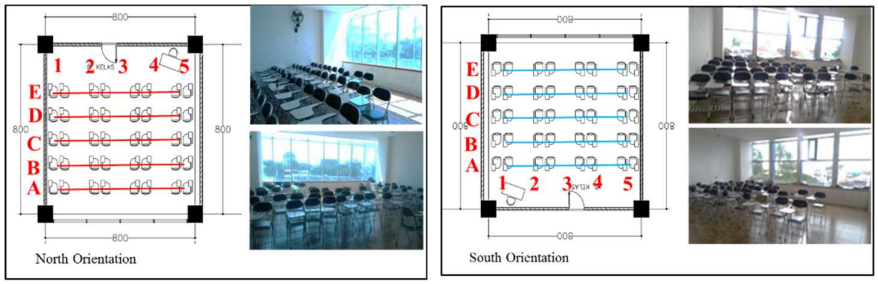

Figure 7 Classroom position and seat placement (Floors 2,3, and 4)

This lecture room is located on floors 2,3, and 4 and is equipped with 50 lecture chairs, teaching desks, and blackboards. Measurements follow the placement of the lecture chair. Measurements were repeated three times at the same point. The sky condition at the time of measurement is a clear sky with an illumination level outside the building or open area of 159500 lux.

Table 3 Measuring points, rooms, and measurement notation light intensity

Measuring Point	Room	Light Intensity (Lux)				
A1 – A5	**201**	197	177	150	135	121
B1 – B5	**North**	347	186	164	142	138
C1 – C5		423	324	247	176	169
D1 – D5		558	402	356	286	211
E1 – E5		594	482	334	281	254
E1 – E5	**206**	633	489	468	285	275
D1 – D5	**South**	496	471	320	280	231
C1 – C5		437	368	289	272	231
B1 – B5		285	319	279	262	190
A1 – A5		275	175	124	116	112
Measuring Point	**Room**	**Light Intensity (Lux)**				
A1 – A5	**301**	134	139	180	230	168
B1 – B5	**North**	154	175	200	230	170
C1 – C5		269	279	288	289	250
D1 – D5		321	341	356	304	290
E1 – E5		387	398	402	365	300
E1 – E5	**306**	453	478	543	314	211
D1 – D5	**South**	401	465	330	300	200
C1 – C5		384	386	289	272	175
B1 – B5		327	301	250	280	167
A1 – A5		211	178	200	241	150
Measuring Point	**Room**	**Light Intensity (Lux)**				
A1 – A5	**401**	150	177	150	200	211
B1 – B5	**North**	278	256	164	142	138
C1 – C5		329	339	247	250	240
D1 – D5		459	457	356	321	250
E1 – E5		501	482	330	281	259
E1 – E5	**406**	404	431	378	350	279

D1 – D5	**South**	365	378	309	301	288
C1 – C5		354	368	289	272	231
B1 – B5		221	248	250	265	266
A1 – A5		204	245	250	265	269

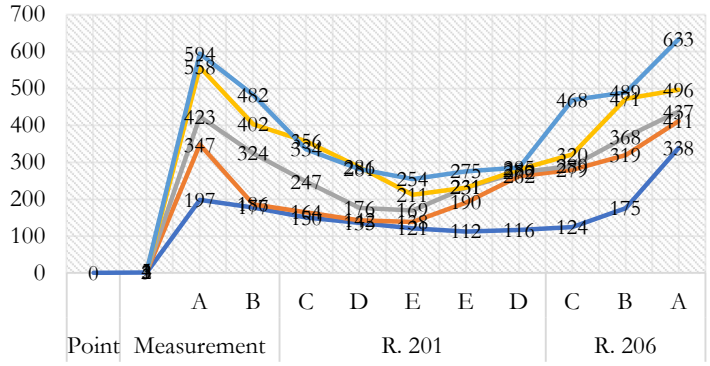

Figure 8 Graph of floor light intensity 2

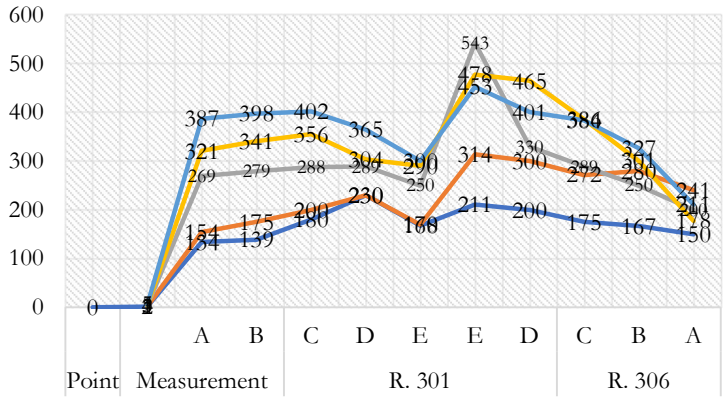

Figure 9 Graph of 3 floor light intensity

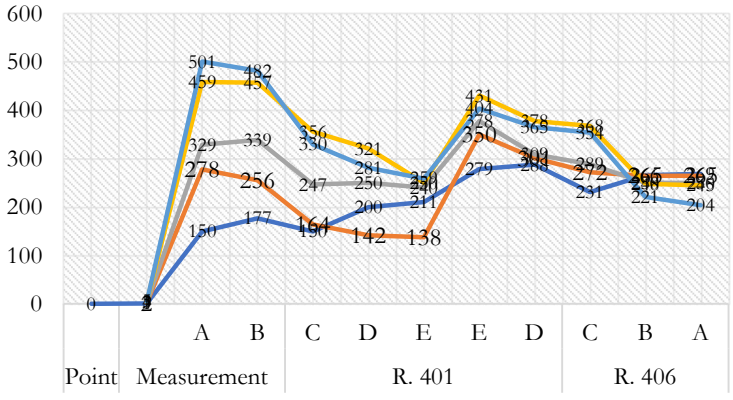

Figure 10 Graph of 4 floor light intensity

The results of the measurement of light intensity based on Figures 8, 9, and 10 show the level of light intensity of the lecture hall on the R.201 floor as follows: (1) measuring points A1 – A5 have a maximum value of 594 lux and a minimum of 197 lux; (2) measuring points B1 – B5 have a maximum value of 482 lux and a minimum of 151 lux; (3) measuring points C1 – C5 have a maximum value of 356 lux and a minimum of 105 lux; (4) measuring points D1 – D5 have a maximum value of 301 lux and a minimum of 98 lux; (5) measuring points E1 – E5 have a maximum value of 254 lux and a minimum of 97 lux. In class room R.206 South orientation with measuring points A1 – A5 has maximum and minimum values (max – mini) 633 – 338 lux, measuring point B1 – B5 = 489 – 175 lux, measuring point C1 – C5 = 468 – 124 lux , measuring points D1 – D5= 285 – 116 lux, and measuring points E1 – E5= 275 – 112 lux.

Measurement of the light intensity of the lecture hall on the 3rd floor, namely R.301 (North) with a minimum - maximum measuring point as follows (1) measuring point A1-A5 = 134 – 387 lux, (2) measuring point B1-B5 = 139 – 398 lux , (3) measuring point C1-C5 = 180 – 402 lux, (4) measuring point D1-D5 = 230 – 365 lux, (5) measuring point E1-E5 = 168 – 300 lux while the lecture hall R.306 (South) with a minimum - maximum measuring point as follows (1) measuring point E1-E5 = 211 - 453 lux, (2) measuring point D1-D5 = 200 - 401 lux, (3) measuring point C1-C5 = 175 – 384 lux, (4) measuring point B1-B5 = 167 – 327 lux, (5) measuring point A1-A5 = 150 – 211 lux.

Measurement of the light intensity of the lecture hall on the 4th floor, namely R.401 (North) with a minimum - maximum measuring point as follows (1) measuring point A1-A5 = 150 – 501 lux, (2) measuring point B1-B5 = 177 – 482 lux , (3) measuring point C1-C5 = 150 – 330 lux, (4) measuring point D1-D5 = 200 – 281 lux, (5) measuring point E1-E5 = 211 – 259 lux while the lecture hall R.406 (South) with a minimum - maximum measuring point as follows (1) measuring point E1-E5 = 279 - 404 lux, (2) measuring point D1-D5 = 288 - 365 lux, (3) measuring point C1-C5 = 231 – 354 lux, (4) measuring point B1-B5 = 266 – 221 lux, (5) measuring point A1-A5 = 269 – 204 lux.

The results of the analysis on the lecture classrooms on the 2nd, 3rd, and 4th floors show that the farther away from the glass envelope of the building, the lower the light intensity level. The measuring point E is the area closest to the building's glass envelope so that the value of the light intensity is large, Table 3 shows the room and the measuring point that the farther away from the glass envelope the building is, the lower the level of light intensity. Based on the results of this analysis, from the three measurement floors with a North – South orientation, the level of illumination is higher and spreads out in a North orientation than in a South orientation and the illumination is very high in the area closest to the building's glass envelope.

4. DICUSSION

The findings of the factor that form visual quality based on user perception are in harmony with the existing theory. In the 2000 IESNA standard, factors that need to be avoided to get a good visual quality of space are glare, shadow and flicker. User perception also states the same thing, namely the presence of lighting as a dominant factor that affects visual quality. In this study, users' perceptions of visual quality were found to be more open and varied. In addition to lighting, other factors expressed by respondents were in terms of furniture, space, use of curtains and atmosphere/impression of space. Most of respondents' perception of visual comfort said that visual quality is important in influencing the continuity of teaching and learning activities.

All visual quality factors directly and indirectly have a relationship with user response. The visual quality factor without using artificial light is the most dominant factor in the formation of the quality of light intensity in the room, the impact caused by the use of artificial light is the atmosphere in the room becomes hot and there is a shadow effect in the space. This finding is supported by research by Gou, Lau, and Qian (2015) which states that there is a change in students' feelings when they are in a learning environment with natural and artificial lighting.

Students' moods increased when they were in a learning environment with natural lighting compared to when in a learning environment with artificial lighting. This shows the importance of designing appropriate lighting in the learning environment to support learning comfort, especially from a psychological perspective of students.

Then the forming factor of visual quality during the teaching and learning process, namely the use of projector (LCD) is the most dominant factor in the formation of light quality, this is due to the emotional response and attitude (affective) so that users feel comfortable in lecture activities. The factor of the area of the room and the arrangement of furniture are also important things in improving the learning atmosphere in the room. The use of curtains has a low frequency because it has an impact on the quality of light in the room. The factor with the dominant frequency has a close relationship, namely lighting as a factor forming visual quality and affective response as the impact of visual quality on lecture room users. This shows that the ideal visual quality can be a positive or negative impact depending on the user and the factors that shape the visual quality of the space.

Measurement of light intensity shows that the level of illumination in the lecture hall area which is oriented towards the north is higher and spreads out than the orientation towards the south, especially during the day. There is a difference in the level of illumination at measuring points C, D, and E, while measuring points A and B are also different, but close to the same. The level of illumination is higher and spread out in the North orientation than in the South orientation. Furthermore, the light intensity affects the distance of the measuring point from the opening of the building's glass envelope. The orientation of the building affects the level of illumination in the room. During the day, the illumination level is higher in the North orientation direction than in the South orientation direction, especially the measuring point in the area close to the building envelope opening. The treatment of the facade of the building can also affect the level of illumination in the room. Based on the results of the calculation of light intensity, it is found that the average level of light quality on the three floors of the room exceeds the SNI Standard for lecture rooms of 250 lux.

Research on user perceptions of visual quality is important to discuss, because good visual quality causes the comfort level of the space to increase and affects user activities in it. Further research is needed on the visual concept of the ideal lecture room to obtain results that can be applied empirically. In this study only limited to visual forming factors. It is hoped that in the future research on perception of visual quality in lecture halls will use external and internal factors in the building, and may also involve more diverse respondents or respondents who are more limited (specifically in certain student groups) so that the results obtained can represent user perceptions of various characteristics. users and location of lecture rooms.

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