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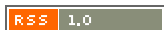
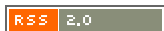
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TERAKREDITASI



The Impact of Café Lighting on Customer Comfort Perception: A Case Study of Threelogy Coffee and Zybrick Coffee and Cantina, Surabaya

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ABSTRACT

The evolution of cafés as multifunctional spaces for dining, socializing, and working has significantly influenced the standards for lighting. Previous research has shown that while café lighting frequently falls short of SNI standards, this does not impede the space's functionality, and the effects of these deficiencies on customer experiences remain largely unexplored. This study investigates the light intensity and customer comfort at Threelogy Coffee and Zybrick Coffee and Cantina, two cafés characterized by markedly different designs and lighting conditions. Field surveys and light intensity measurements using lux meter were conducted to evaluate the lighting conditions at both locations, while questionnaires were used to assess visitor perceptions of comfort. At Threelogy Coffee, light intensity levels are notably high, with indoor measurements ranging from 360 to 465 lux and reaching up to 34,705 lux in semi-outdoor areas. Conversely, Zybrick Coffee and Cantina exhibits lower light intensity, with indoor levels between 65 and 70 lux and semi-outdoor areas ranging from 240 to 670 lux. Survey results reveal that customers to Threelogy Coffee generally express satisfaction with the bright lighting, although there is a potential risk of long-term monotony. Meanwhile, customers to Zybrick Coffee and Cantina report comfort despite the dim lighting, which is attributed to the private and intimate atmosphere fostered by the café's design. Both cafés exhibit comparable levels of overall comfort, highlighting the significance of atmospheric design elements, in addition to lighting, in creating a positive customer experience. These findings indicate that cafés should adopt a range of lighting intensities along with careful interior design, utilizing both bright and dim options to cater to various activities. This could include providing warm spotlighting and cooler daylight, allowing patrons to comfortably relax, read, and work.

Keywords: atmosphere, cafés, lighting, visual comfort

1. Introduction

In the modern era, the role of cafes has evolved well beyond just being a place to eat. Today, cafes often serve as multifunctional spaces for socializing, working, studying, and hosting business or social meetings. [1], [2]. Along with this shift in function, café lighting standards have also undergone significant changes [3]. Lighting, which plays a crucial role in creating an appropriate and comfortable atmosphere, can directly impact customer comfort and productivity [4], [5].

Lighting, color, room decor, and aroma are critical factors that influence the atmosphere of a café and significantly impact its appeal and customer comfort. In addition to supporting various activities, lighting also plays a crucial role in shaping the overall ambiance of the space [6], [7]. Light intensity, color temperature,

and light distribution significantly influence visitor activities in coffee shops, as observed through both perception and field studies. Higher light intensity correlates with more complex activities, such as working, studying, and meetings, while lower intensity is associated with simpler social interactions. While color temperature impacts how visitors engage with the environment; warmer light colors encourage relaxation and casual conversations, whereas cooler, white light supports both socializing and more focused tasks [8]. AbuThahir et al. [7] mentioned that dimmed lighting creates an intimate atmosphere, but adequate brightness is necessary for enhancing visual comfort, as proper lighting significantly enhances customer impressions, revisit intentions, and perceptions of service quality in cafés. The integration of natural and artificial lighting creates a tranquil and inviting atmosphere, significantly influencing visual comfort. Factors that affect this comfort include lighting conditions, which can impact mood and overall well-being; the interplay of light and color, which helps establish specific atmospheres; and the presence of excessive sunlight, which can negatively affect user comfort [9]. Wardono et al. [10] recommends achieving visual comfort by establishing a harmonious ambiance and color scheme that influences people's emotions. However, the influx of daylight in a café should be noted, sometimes it can be too intense, as excessive brightness may disrupt the overall atmosphere. According to Putri et al. [11], the design of lighting in cafés must consider both visual comfort and psycho-visual comfort. Visual comfort is influenced by the intensity of light, which should be adequate for the activities being performed. Psycho-visual comfort, on the other hand, is affected by the stimuli from the surrounding lighting conditions that influence visitors' visual perceptions, emotions, and behaviors. Psycho-visual comfort refers to how the physical environment creates visual perceptions, emotions, and human behaviors. Proper lighting enhances the functionality of the space and creates a pleasant atmosphere, which can improve the customer experience and attract more customers.

In the context of cafés serving as both dining and working spaces, it is crucial to understand that these activities require different lighting levels. According to the SNI 6197:2020 standard on energy conservation in lighting systems, cafés or dining areas should have lighting levels between 100 and 250 lux. In contrast, workspaces need higher lighting levels, around 350 lux [12]. However, several studies on cafe lighting reveal that light intensity often falls short of SNI standards. Maggiet T et al. [13] noted that many restaurants overlook the functional aspect of lighting. It appears that the lighting standards in these spaces are not aligned with the needs of visitors or staff. Research at Starbucks Coffee in Cambridge City Square showed that light intensity levels do not fully comply with visual comfort standards as per SNI [14]. Similarly, Novrial et al. [8] measured light intensity at Tamoe Coffee and Resto and Makecents Coffee and Space in Medan, finding that Tamoe Coffee and Resto had a range of 100 to 155 lux, while Makecents Coffee and Space ranged from 80 to 200 lux. Putri [15] reported an average light intensity of just 58.21 lux at Caloria Cafe in Surabaya. In another study, Yahya et al. [16] measured light intensity at over 100 points in Good Dank Coffee Shop in Malang at various times and found most measurements were below 250 lux. Additionally, Ahda et al. [17] indicated that five out of six measurement points at Starbucks Jatiuwung in Banten registered below 250 lux. At Tanatap Ring Garden Coffee Shop in Ampera Jakarta, light intensity measurements across three areas showed that only two areas met SNI standards, while the third area fell below 250 lux. This was due to the latter area being designed for a relaxing atmosphere, while the other two were intended for work activities.

Given that 80% of information is processed visually, lighting is essential in shaping a space's atmosphere [18]. As cafés evolve into multifunctional dining environments which require different lux level to accomodate various activities, research on appropriate lighting in cafés becomes increasingly important [19]. Adequate lighting not only enhances safety but also contributes to customer comfort and satisfaction [20]. While existing studies often explore the link between lighting design and customer behavior in cafés [6], [7], few focus specifically on how varying lighting conditions impact customers' perceptions and comfort. Although previous research has indicated that café lighting often falls below SNI standards, this discrepancy does not hinder the space's functionality as a place for visitors' activities at the coffee shop and the implications of these deficiencies on customer experiences have not been thoroughly investigated [8]. This study aims to fill this gap by examining how different lighting levels influence perceptions of comfort, providing valuable insights for café owners and designers seeking to create optimal dining environments.

2. Method

2.1 Case studies

This study seeks to assess how different lighting levels affect customer comfort at two cafés with distinctly different design characteristics and lighting conditions: Threelogy Coffee and Zybrick Coffee and Cantina. Threelogy Coffee and Zybrick Coffee and Cantina were selected as case studies because both serve similar functions as dining spots and gathering places for young people (Figure 1). Threelogy Coffee, located on Mojopahit street, is near educational institutions such as Widya Mandala Catholic University and Santa Maria High School. Zybrick Coffee and Cantina is situated on Siwalankerto street, close to Petra Christian University. Choosing these two cafés allows for a comprehensive evaluation of how lighting impacts customer comfort in environments that both cater to academic and young professional communities.



Figure 1 (a) Building facades of Threelogy Coffee and (b) Zybrick Coffee and Cantina.

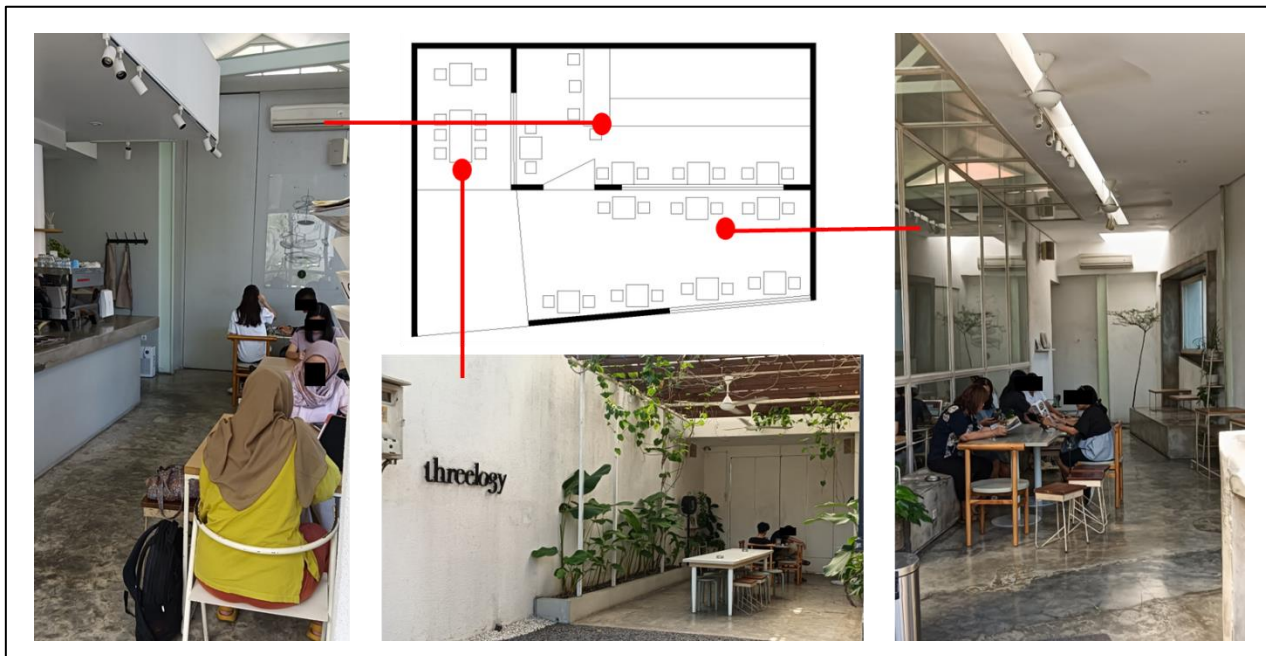


Figure 2 Atmosphere of Threelogy Coffee.

Although both cafés serve similar functions and target audiences as dining, social, and workspaces, their interior designs are markedly different in terms of natural lighting, color schemes, and materials. These design differences create a contrasting atmosphere between the two cafés [21]. Threelogy Coffee utilizes natural lighting through windows and skylights and features exposed concrete with bright colors such as white and gray (Figure 2). Threelogy Coffee exemplifies a modern café design that heavily relies on natural lighting. Its

façade features numerous large windows that allow maximum sunlight to enter, while skylights further enhance the natural light, creating a bright and airy atmosphere throughout the day. The use of white walls and ceilings, along with exposed concrete, reflects light and improves overall illumination within the space. This design creates an impression of spaciousness, minimalism, and cleanliness while also imparting a sense of freshness. Beyond its visually appealing effect, it enhances customer comfort through its bright lighting.



Figure 3 Atmosphere of the ground floor of Zybrick Coffee and Cantina.

Conversely, Zybrick Coffee and Cantina operates on a different principle. Relying primarily on artificial lighting, this café creates a more intimate and private atmosphere. Interior materials such as exposed brick and dark wood with a dark-colored ceiling are selected to impart a warm and luxurious feel, though this also limits natural light entry (Figure 3). Artificial lighting, strategically designed, aims to create a cozy ambiance that supports socializing and working. Although the lighting intensity might not meet the optimal standards for workspaces, the interior design offers a unique and attractive visual quality. This design creates a more private, luxurious, elegant, comfortable, and warm atmosphere [22], [23].

2.1 Field measurement and questionnaire survey

This study employs field survey and questionnaire to evaluate lighting and comfort at Threelogy Coffee and Zybrick Coffee and Cantina. The field survey involves measuring light intensity and documenting the lighting conditions in both cafés. To capture accurate data on natural illumination, measurements at Threelogy Coffee were conducted at noon when sunlight is most intense, specifically on August 31, between 11:00 AM and 2:00 PM. Similarly, the survey at Zybrick Coffee and Cantina was carried out on August 3, during the same time frame.

A lux meter was employed to measure light intensity at key locations throughout the cafés, including dining tables, semi-outdoor areas, and near windows (Figure 4). The lux meter was placed directly on the tables. Although Zybrick Coffee and Cantina has two floors available for dining, this study focused solely on the ground floor due to the second floor being closed at the time of the survey and questionnaire administration. The collected light intensity data, measured in lux, were analyzed to determine whether the lighting meets the standards for dining and workspaces as defined by SNI.

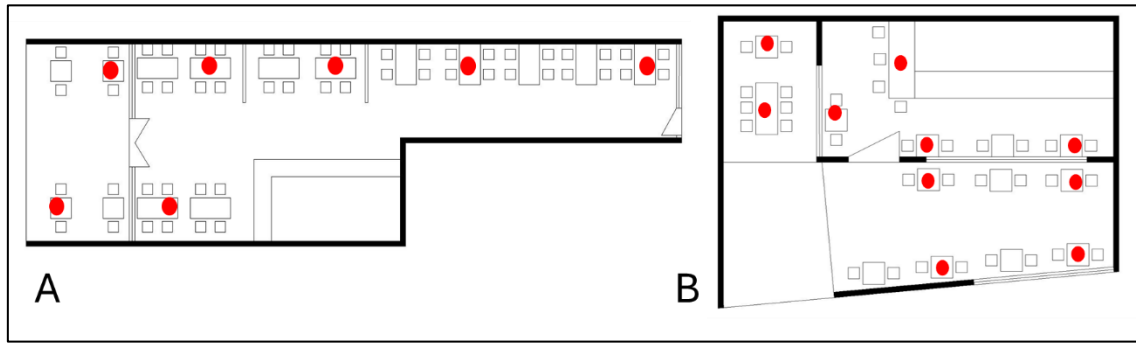


Figure 4 Measurement points at Zybrick Coffee and Cantina (a) and Threelogy Coffee (b).

In addition to the field survey, questionnaires are distributed to customers present at the cafés during the field survey. The questionnaires are designed to gather data on customers' perceptions of lighting and café comfort. They include questions about lighting levels, visual comfort, atmospheric comfort, and overall satisfaction. Respondents rate their experience on a scale of 1 to 4, where 1 indicates dissatisfaction and 4 indicates maximum satisfaction (Figure 5).

On August 31, during the survey at Threelogy Coffee, questionnaires were given to 20 customers between 11:00 AM and 2:00 PM. At Zybrick Coffee and Cantina, on August 3, 18 customers were surveyed during the same time frame. The collected questionnaire data will be analyzed to identify patterns and trends in customer perceptions of lighting and ambiance at each café. The findings from both the light intensity measurements and the questionnaire responses will be compared and analyzed to evaluate visitor perceptions of lighting and comfort in each location.

Café Condition Assessment Questionnaire Based on Customer Perception

Instructions: Please rate the following aspects of the café based on your experience, using a scale of 1 to 4. Your responses will help us understand and improve the café environment.

1. On a scale of 1 to 4, how would you rate the lighting level at this café?
 - 1 – Poor: The lighting is inadequate and uncomfortable.
 - 2 – Fair: The lighting is somewhat adequate but could be improved.
 - 3 – Good: The lighting is sufficient and generally comfortable.
 - 4 – Excellent: The lighting is optimal and enhances the overall experience.
2. On a scale of 1 to 4, how would you rate the visual comfort at this café?
 - 1 – Poor: The visual comfort is uncomfortable or bothersome.
 - 2 – Fair: The visual comfort is somewhat adequate but could be improved.
 - 3 – Good: The visual comfort is generally pleasant and suitable.
 - 4 – Excellent: The visual comfort is optimal and enhances the overall experience.
3. On a scale of 1 to 4, how would you rate the comfort of the ambiance at this café?
 - 1 – Poor: The ambiance is uncomfortable or uninviting.
 - 2 – Fair: The ambiance is somewhat pleasant but could be improved.
 - 3 – Good: The ambiance is generally comfortable and enjoyable.
 - 4 – Excellent: The ambiance is highly comfortable and creates a very pleasant experience.
4. On a scale of 1 to 4, how would you rate the overall comfort at this café?
 - 1 – Poor: The overall comfort is unsatisfactory.
 - 2 – Fair: The overall comfort is acceptable but could be improved.
 - 3 – Good: The overall comfort is generally satisfactory and pleasant.
 - 4 – Excellent: The overall comfort is outstanding and enhances the entire experience.

Figure 5 Questionnaire for evaluating café conditions based on customer perceptions.

3. Results and Discussion

3.1 Light intensity measurements

Light intensity measurements were taken at several key locations in both cafés. At Threelogy Coffee, measurements were conducted in the indoor area, near the windows, and in the semi-outdoor space. In contrast, measurements at Zybrick Coffee and Cantina were taken in the indoor area, the semi-outdoor space, and near artificial lighting sources.

At Threelogy Coffee, light intensity measurements reveal significant variations between indoor and semi-outdoor areas. The indoor area has lux level ranging from 360 to 465 lux, while near the windows, the level reaches up to 3,460 lux. In the semi-outdoor areas, lux level varies from 723 to 1,535 lux, and in some parts of the semi-outdoor space, it can peak between 4,245 and 34,705 lux (Figure 6). These results indicate that Threelogy Coffee features very high lux levels, particularly in the semi-outdoor areas, which far exceed the standard lux levels for dining and workspaces. In contrast, Zybrick Coffee and Cantina exhibits lower light intensity compared to Threelogy Coffee. Measurements in the indoor area show lux level ranging from 65 to 70 lux, while in the semi-outdoor areas, it ranges from 240 to 670 lux (Figure 7). This lux level falls within the standard range for dining and workspaces. The lower lux level at Zybrick Coffee and Cantina is attributed to the minimal natural light entering the indoor area and the use of dark-colored materials, which reduce light reflectance.

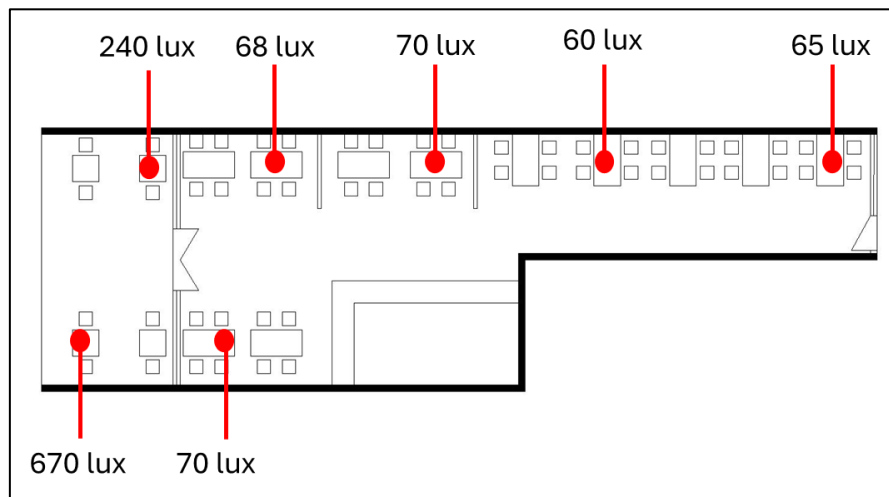


Figure 6 The light intensity measurements at Zybrick Coffee and Cantina.

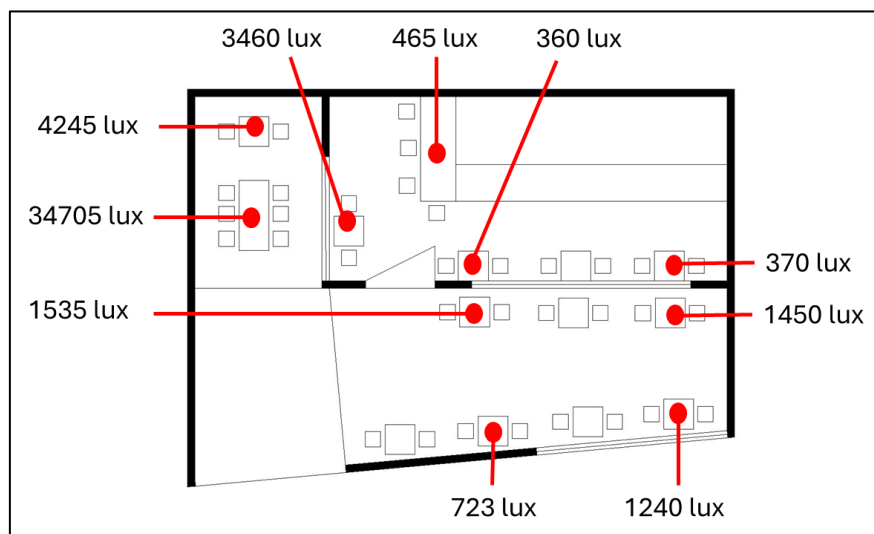


Figure 7 The light intensity measurements at Threelogy Coffee.

According to SNI standards, Threelogy Coffee has attained the required lux level for visual comfort, meeting the necessary criteria for both dining and working. However, the lux levels in the semi-outdoor area often exceed 1000 lux, which could lead to visual discomfort. In contrast, Zybrick Coffee and Cantina did not meet the visual comfort standards, as their lux levels fall significantly below the minimum required for these activities.

3.2 Questionnaire survey results

Questionnaire survey results (Figure 8) show that customers to Threelogy Coffee generally perceive the café as bright and visually appealing. About 75% of respondents rated the visual comfort as either 3 or 4 (good or excellent), while 70% rated the ambiance comfort as 3 (good). Overall, 80% of customers felt comfortable, scoring 3 or 4. These findings are consistent with the light intensity measurements, which reveal that Threelogy Coffee has exceptionally bright lighting.

In contrast, customers to Zybrick Coffee and Cantina often describe the café as relatively dim. Approximately 77.78% rated the lighting as 1 or 2 (poor or fair). Despite this, many still reported feeling comfortable, with 55.56% rating visual comfort as 3 or 4 (good or excellent), and 77.78% rating ambiance comfort as 3 or 4. These results suggest that, although Zybrick Coffee and Cantina has lower lighting levels, its ambiance still provides a high level of comfort for its guests and in general, 77.78% of the respondents felt comfortable.

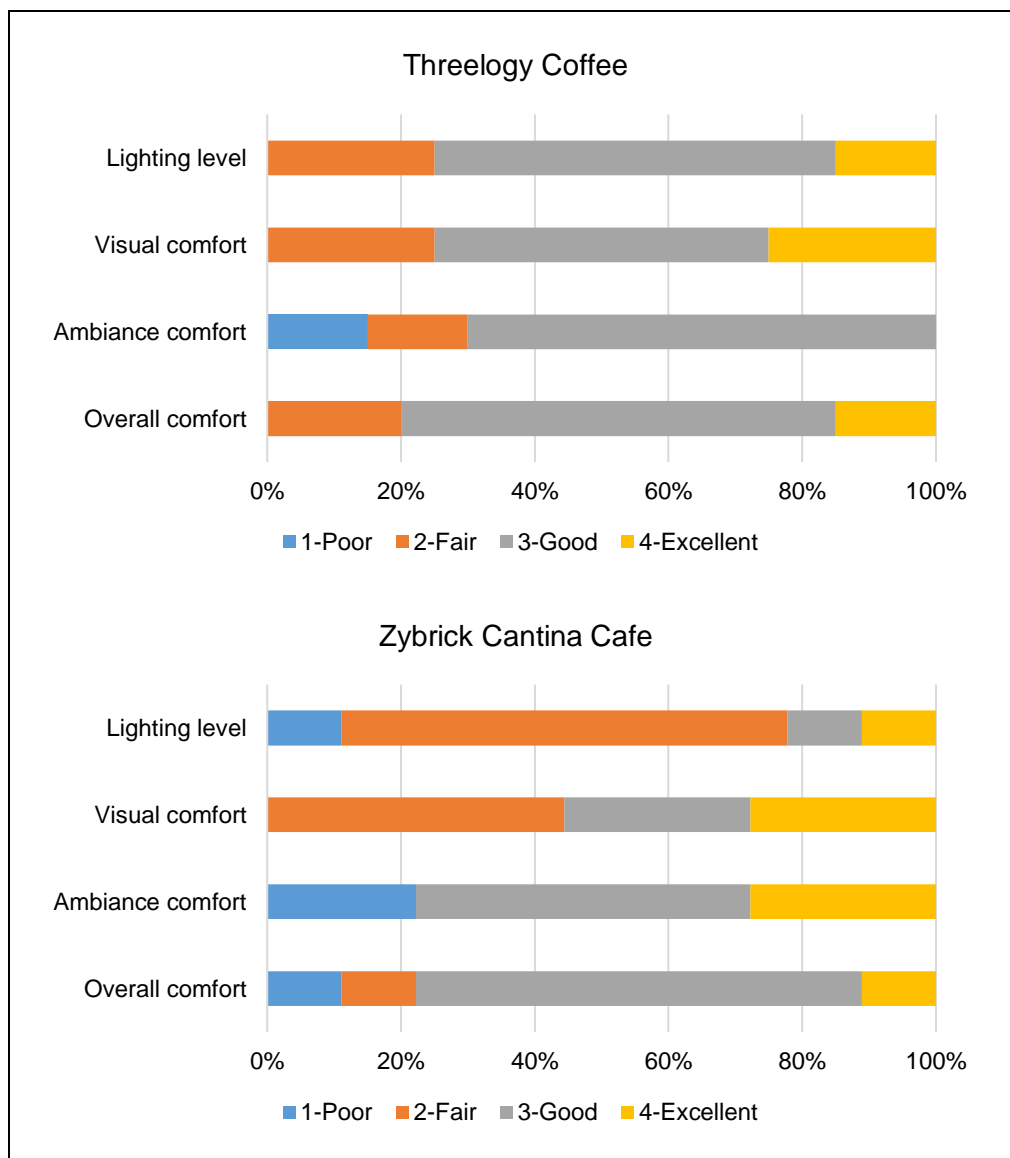


Figure 8 Questionnaire survey results for Threelogy Coffee and Zybrick Coffee and Cantina.

3.3 Discussions

The lighting at Threelogy Coffee is notably bright, especially in the semi-outdoor areas, with light intensity surpassing the standard levels for dining and workspaces. This high level of illumination is attributed to sunlight streaming through large windows and skylights, as well as reflections from white materials on the ceiling and walls. The bright lighting effectively draws customers' attention to the menu and food, enhancing visual comfort during meals [17]. However, excessively bright lighting can create a cold and monotonous atmosphere if customers spend extended periods in the café [23]. Research by Farooq et al. in [24] suggests that while very bright lighting provides good short-term visual comfort, it can lead to a sense of monotony and boredom over time. Questionnaire survey results indicate that customers at Threelogy Coffee are generally satisfied with the bright and visually comfortable lighting. However, the very bright lighting could impact long-term customer comfort, suggesting that lighting design should also consider the overall ambiance.

In contrast, the low lighting at Zybrick Coffee and Cantina is due to limited natural light and the use of dark-colored materials that reduce light reflectance. Although the light intensity falls below the ideal standards for dining and workspaces, the interior design—featuring exposed brick and dark wood—creates a warm and cozy atmosphere [21]. The artificial lighting used in the interior design contributes to a private and relaxing ambiance, particularly for customers who come to work or socialize. This aligns with findings that dim lighting can foster a relaxing and comfortable environment [25], [26]. Although customers at Zybrick Coffee and Cantina perceive the café as dim, they still find it comfortable due to its intimate atmosphere and interior design that fosters a sense of privacy. This suggests that a well-designed ambiance can compensate for deficiencies in light intensity, as previous research highlights that a well-crafted ambiance can enhance customer comfort even when lighting does not meet ideal standards [27], [28].

The research highlights a gap indicating that café lighting often falls short of SNI standards, yet this does not significantly impact the café's function. The findings suggest that the ambiance and overall comfort experienced by respondents at Zybrick Coffee and Cantina and Threelogy Coffee are not notably different. This can be attributed to the fact that while Threelogy Coffee's lux levels meet the requirements for dining and working, some areas exceed 1000 lux, which may cause visual discomfort. A café's comfortable atmosphere arises from the combination of lighting, interior design, color, and materials. The minimalist design and white surfaces in the ceilings and walls enhance light reflection and overall brightness. According to Mulyati in [23] and Farooq et al. in [24], excessively bright lighting can result in a cold, monotonous environment if customers find high light intensity uncomfortable. Furthermore, Trisna et al. in [29] found that customers prefer cafés that maintain the essence of a café, where the lighting is not as harsh as in office settings.

In contrast, Zybrick Coffee and Cantina use dark materials and artificial lighting to create a cozy, private atmosphere. This design strategy reduces light intensity but enhances intimacy, promoting customer comfort even if the lighting doesn't meet ideal standards [22]. According to AbuThahir et al. in [7], dim lighting contributes to a warm and private setting, increasing relaxation and comfort. Cafés with this type of lighting are more appealing to customers, as the warm ambiance stimulates their psycho-visual comfort [8], [10]. In this context, dim lighting fosters an environment conducive to socializing and working, suggesting that psycho-visual comfort can offset any deficiencies in visual comfort and light intensity.

Despite the differences in lighting intensity and ambiance between Zybrick Coffee and Cantina and Threelogy Coffee, respondents found both cafés to be comfortable. This suggests that effective café lighting should incorporate both bright and dim options to accommodate various activities, as noted by Putri in [11]. Vincent et al. in [30] further support this idea, stating that customers favor cafés that utilize natural materials and colors to foster a warm atmosphere, complemented by open areas with windows. As a result, this café offers two types of lighting: warm spotlighting and cooler daylight, which enables patrons to comfortably engage in activities like relaxing, reading, and working.

A café not only sells products; the atmosphere it provides is a crucial element that consumers look for in their experience [31]. Atsnawiyah et al. in [32] and Omar et al. in [33] suggest that a pleasant café environment can enhance the likelihood of customers returning, which can positively affect the café's revenue. However, this study is limited to examining the influence of café lighting on customer comfort perception. Future research could be broadened to explore how café lighting impacts customers' health, productivity, and likelihood of returning, as these are also vital for sustaining the café business.

4. Conclusion

This study investigates lighting in cafés as multifunctional spaces that accommodate dining, socializing, working, and both formal and informal meetings. Previous research has shown that café lighting often does not meet SNI standards, yet this shortfall does not significantly affect the space's functionality for visitors. However, the impact of these lighting deficiencies on customer experiences has not been extensively explored. This study seeks to address this gap by examining how varying lighting levels influence perceptions of comfort, offering valuable insights for café owners and designers aiming to create optimal dining environments.

Threelogy Coffee and Zybrick Coffee and Cantina were selected as case studies to analyze the impact of lighting on customer perceptions and comfort. Threelogy Coffee features exceptionally high lighting intensity, exceeding the standards for dining and workspaces, particularly in the semi-outdoor areas, due to sunlight entering through large windows and skylights, and the reflective properties of white walls and ceilings. In contrast, Zybrick Coffee and Cantina has lighting intensity below the ideal standard but creates a cozy and private atmosphere with artificial lighting and dark interior materials.

Survey results indicate that customers to Threelogy Coffee are generally satisfied with the bright lighting, although there is potential for long-term monotony. Conversely, customers to Zybrick Coffee and Cantina appreciate the private ambiance, despite the dim lighting. These results emphasize that beyond just lighting, the overall ambiance of the café—comprising lighting, materials, and colors—significantly influences the quality of the customer experience.

To improve customer experience, cafés should focus on using varied lighting intensities along with thoughtful interior design. This indicates that effective café lighting should include both bright and dim options to support different activities. The café could provide two types of lighting: warm spotlighting and cooler daylight, allowing patrons to comfortably engage in activities such as relaxing, reading, and working.

Further research could explore how lighting and interior design impact various aspects of customer experience, including productivity, health, and overall satisfaction. By gaining a deeper understanding of how lighting, design, and customer comfort interact, cafés can better optimize the customer experience, enhancing both appeal and customer satisfaction.

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6. Conflict of Interest

The authors certify that the manuscript does not have a conflict of interest.

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The Impact of Café Lighting on Customer Comfort Perception: A Case Study of Threelogy Coffee and Zybrick Coffee and Cantina, Surabaya

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ABSTRACT

The evolution of cafés as multifunctional spaces for dining, socializing, and working has significantly influenced the standards for lighting. Previous research has shown that while café lighting frequently falls short of SNI standards, this does not impede the space's functionality, and the effects of these deficiencies on customer experiences remain largely unexplored. This study investigates the light intensity and customer comfort at Threelogy Coffee and Zybrick Coffee and Cantina, two cafés characterized by markedly different designs and lighting conditions. Field surveys and light intensity measurements using lux meter were conducted to evaluate the lighting conditions at both locations, while questionnaires were used to assess visitor perceptions of comfort. At Threelogy Coffee, light intensity levels are notably high, with indoor measurements ranging from 360 to 465 lux and reaching up to 34,705 lux in semi-outdoor areas. Conversely, Zybrick Coffee and Cantina exhibits lower light intensity, with indoor levels between 65 and 70 lux and semi-outdoor areas ranging from 240 to 670 lux. Survey results reveal that customers to Threelogy Coffee generally express satisfaction with the bright lighting, although there is a potential risk of long-term monotony. Meanwhile, customers to Zybrick Coffee and Cantina report comfort despite the dim lighting, which is attributed to the private and intimate atmosphere fostered by the café's design. Both cafés exhibit comparable levels of overall comfort, highlighting the significance of atmospheric design elements, in addition to lighting, in creating a positive customer experience. These findings indicate that cafés should adopt a range of lighting intensities along with careful interior design, utilizing both bright and dim options to cater to various activities. This could include providing warm spotlighting and cooler daylight, allowing patrons to comfortably relax, read, and work.

Keywords: atmosphere, cafés, customer comfort, lighting, visual comfort

1. Introduction

In the modern era, the role of cafes has evolved well beyond just being a place to eat. Today, cafes often serve as multifunctional spaces for socializing, working, studying, and hosting business or social meetings. [1], [2]. Along with this shift in function, café lighting standards have also undergone significant changes [3]. Lighting, which plays a crucial role in creating an appropriate and comfortable atmosphere, can directly impact customer comfort and productivity [4], [5].

Lighting, color, room decor, and aroma are critical factors that influence the atmosphere of a café and significantly impact its appeal and customer comfort. In addition to supporting various activities, lighting also plays a crucial role in shaping the overall ambiance of the space [6], [7]. Light intensity, color temperature,

and light distribution significantly influence visitor activities in coffee shops, as observed through both perception and field studies. Higher light intensity correlates with more complex activities, such as working, studying, and meetings, while lower intensity is associated with simpler social interactions. While color temperature impacts how visitors engage with the environment; warmer light colors encourage relaxation and casual conversations, whereas cooler, white light supports both socializing and more focused tasks [8]. AbuThahir et al. [7] mentioned that dimmed lighting creates an intimate atmosphere, but adequate brightness is necessary for enhancing visual comfort, as proper lighting significantly enhances customer impressions, revisit intentions, and perceptions of service quality in cafés. The integration of natural and artificial lighting creates a tranquil and inviting atmosphere, significantly influencing visual comfort. Factors that affect this comfort include lighting conditions, which can impact mood and overall well-being; the interplay of light and color, which helps establish specific atmospheres; and the presence of excessive sunlight, which can negatively affect user comfort [9]. Wardono et al. [10] recommends achieving visual comfort by establishing a harmonious ambiance and color scheme that influences people's emotions. However, the influx of daylight in a café should be noted, sometimes it can be too intense, as excessive brightness may disrupt the overall atmosphere. According to Putri et al. [11], the design of lighting in cafés must consider both visual comfort and psycho-visual comfort. Visual comfort is influenced by the intensity of light, which should be adequate for the activities being performed. Psycho-visual comfort, on the other hand, is affected by the stimuli from the surrounding lighting conditions that influence visitors' visual perceptions, emotions, and behaviors. Psycho-visual comfort refers to how the physical environment creates visual perceptions, emotions, and human behaviors. Proper lighting enhances the functionality of the space and creates a pleasant atmosphere, which can improve the customer experience and attract more customers.

In the context of cafés serving as both dining and working spaces, it is crucial to understand that these activities require different lighting levels. According to the SNI 6197:2020 standard on energy conservation in lighting systems, cafés or dining areas should have lighting levels between 100 and 250 lux. In contrast, workspaces need higher lighting levels, around 350 lux [12]. However, several studies on cafe lighting reveal that light intensity often falls short of SNI standards. Maggiet T et al. [13] noted that many restaurants overlook the functional aspect of lighting. It appears that the lighting standards in these spaces are not aligned with the needs of visitors or staff. Research at Starbucks Coffee in Cambridge City Square showed that light intensity levels do not fully comply with visual comfort standards as per SNI [14]. Similarly, Novrial et al. [8] measured light intensity at Tamoe Coffee and Resto and Makecents Coffee and Space in Medan, finding that Tamoe Coffee and Resto had a range of 100 to 155 lux, while Makecents Coffee and Space ranged from 80 to 200 lux. Putri [15] reported an average light intensity of just 58.21 lux at Caloria Cafe in Surabaya. In another study, Yahya et al. [16] measured light intensity at over 100 points in Good Dank Coffee Shop in Malang at various times and found most measurements were below 250 lux. Additionally, Ahda et al. [17] indicated that five out of six measurement points at Starbucks Jatiuwung in Banten registered below 250 lux. At Tanatap Ring Garden Coffee Shop in Ampera Jakarta, light intensity measurements across three areas showed that only two areas met SNI standards, while the third area fell below 250 lux. This was due to the latter area being designed for a relaxing atmosphere, while the other two were intended for work activities.

Given that 80% of information is processed visually, lighting is essential in shaping a space's atmosphere [18]. As cafés evolve into multifunctional dining environments which require different lux level to accommodate various activities, research on appropriate lighting in cafés becomes increasingly important [19]. Adequate lighting not only enhances safety but also contributes to customer comfort and satisfaction [20]. While existing studies often explore the link between lighting design and customer behavior in cafés [6], [7], few focus specifically on how varying lighting conditions impact customers' perceptions and comfort. Although previous research has indicated that café lighting often falls below SNI standards, this discrepancy does not hinder the space's functionality as a place for visitors' activities at the coffee shop and the implications of these deficiencies on customer experiences have not been thoroughly investigated [8]. This study aims to fill this gap by examining how different lighting levels influence perceptions of comfort, providing valuable insights for café owners and designers seeking to create optimal dining environments.

2. Method

2.1 Case studies

This study seeks to assess how different lighting levels affect customer comfort at two cafés with distinctly different design characteristics and lighting conditions: Threelogy Coffee and Zybrick Coffee and Cantina. Threelogy Coffee and Zybrick Coffee and Cantina were selected as case studies because both serve similar functions as dining spots and gathering places for young people (Figure 1). Threelogy Coffee, located on Mojopahit street, is near educational institutions such as Widya Mandala Catholic University and Santa Maria High School. Zybrick Coffee and Cantina is situated on Siwalankerto street, close to Petra Christian University. Choosing these two cafés allows for a comprehensive evaluation of how lighting impacts customer comfort in environments that both cater to academic and young professional communities.



Figure 1 (a) Building facades of Threelogy Coffee and (b) Zybrick Coffee and Cantina.

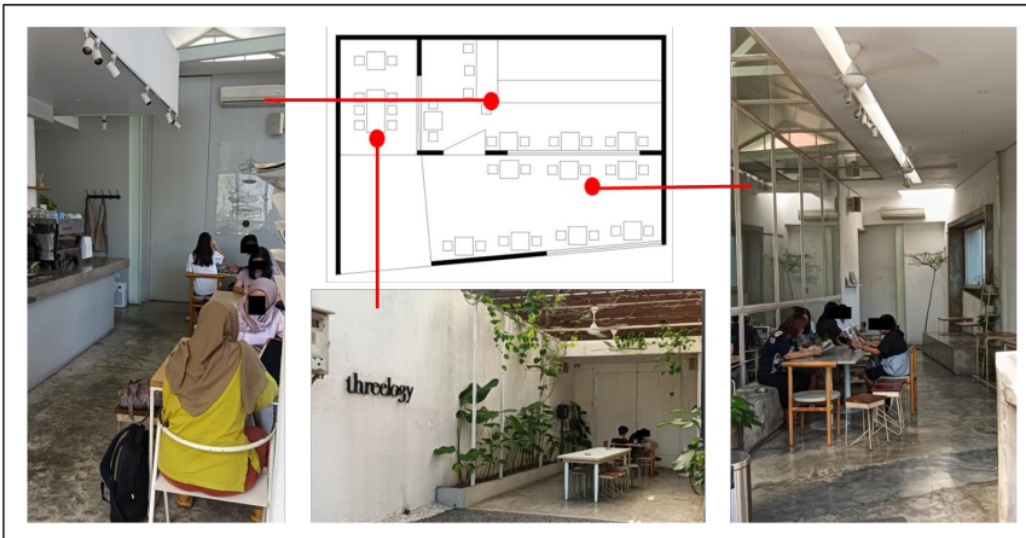


Figure 2 Atmosphere of Threelogy Coffee.

Although both cafés serve similar functions and target audiences as dining, social, and workspaces, their interior designs are markedly different in terms of natural lighting, color schemes, and materials. These design differences create a contrasting atmosphere between the two cafés [21]. Threelogy Coffee utilizes natural lighting through windows and skylights and features exposed concrete with bright colors such as white and gray (Figure 2). Threelogy Coffee exemplifies a modern café design that heavily relies on natural lighting. Its façade features numerous large windows that allow maximum sunlight to enter, while skylights further enhance the natural light, creating a bright and airy atmosphere throughout the day. The use of white walls and ceilings,

along with exposed concrete, reflects light and improves overall illumination within the space. This design creates an impression of spaciousness, minimalism, and cleanliness while also imparting a sense of freshness. Beyond its visually appealing effect, it enhances customer comfort through its bright lighting.



Figure 3 Atmosphere of the ground floor of Zybrick Coffee and Cantina.

Conversely, Zybrick Coffee and Cantina operates on a different principle. Relying primarily on artificial lighting, this café creates a more intimate and private atmosphere. Interior materials such as exposed brick and dark wood with a dark-colored ceiling are selected to impart a warm and luxurious feel, though this also limits natural light entry (Figure 3). Artificial lighting, strategically designed, aims to create a cozy ambiance that supports socializing and working. Although the lighting intensity might not meet the optimal standards for workspaces, the interior design offers a unique and attractive visual quality. This design creates a more private, luxurious, elegant, comfortable, and warm atmosphere [22], [23].

2.1 Field measurement and questionnaire survey

This study employs field survey and questionnaire to evaluate lighting and comfort at Threelogy Coffee and Zybrick Coffee and Cantina. The field survey involves measuring light intensity and documenting the lighting conditions in both cafés. To capture accurate data on natural illumination, measurements at Threelogy Coffee were conducted at noon when sunlight is most intense, specifically on August 31, between 11:00 AM and 2:00 PM. Similarly, the survey at Zybrick Coffee and Cantina was carried out on August 3, during the same time frame.

A lux meter was employed to measure light intensity at key locations throughout the cafés, including dining tables, semi-outdoor areas, and near windows (Figure 4). The lux meter was placed directly on the tables. Although Zybrick Coffee and Cantina has two floors available for dining, this study focused solely on the ground floor due to the second floor being closed at the time of the survey and questionnaire administration. The collected light intensity data, measured in lux, were analyzed to determine whether the lighting meets the standards for dining and workspaces as defined by SNI.

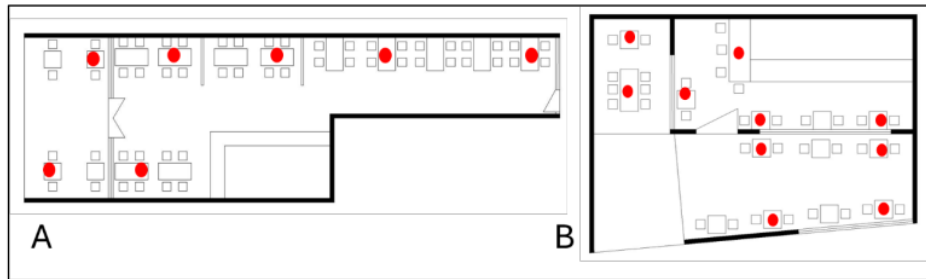


Figure 4 Measurement points at Zybrick Coffee and Cantina (a) and Threelogy Coffee (b).

In addition to the field survey, questionnaires are distributed to customers present at the cafés during the field survey. The questionnaires are designed to gather data on customers' perceptions of lighting and café comfort. They include questions about lighting levels, visual comfort, atmospheric comfort, and overall satisfaction. Respondents rate their experience on a scale of 1 to 4, where 1 indicates dissatisfaction and 4 indicates maximum satisfaction (Figure 5).

On August 31, during the survey at Threelogy Coffee, questionnaires were given to 20 customers between 11:00 AM and 2:00 PM. At Zybrick Coffee and Cantina, on August 3, 18 customers were surveyed during the same time frame. The collected questionnaire data will be analyzed to identify patterns and trends in customer perceptions of lighting and ambiance at each café. The findings from both the light intensity measurements and the questionnaire responses will be compared and analyzed to evaluate visitor perceptions of lighting and comfort in each location.

Café Condition Assessment Questionnaire Based on Customer Perception

Instructions: Please rate the following aspects of the café based on your experience, using a scale of 1 to 4. Your responses will help us understand and improve the café environment.

1. On a scale of 1 to 4, how would you rate the lighting level at this café?
 - 1 – Poor: The lighting is inadequate and uncomfortable.
 - 2 – Fair: The lighting is somewhat adequate but could be improved.
 - 3 – Good: The lighting is sufficient and generally comfortable.
 - 4 – Excellent: The lighting is optimal and enhances the overall experience.
2. On a scale of 1 to 4, how would you rate the visual comfort at this café?
 - 1 – Poor: The visual comfort is uncomfortable or bothersome.
 - 2 – Fair: The visual comfort is somewhat adequate but could be improved.
 - 3 – Good: The visual comfort is generally pleasant and suitable.
 - 4 – Excellent: The visual comfort is optimal and enhances the overall experience.
3. On a scale of 1 to 4, how would you rate the comfort of the ambiance at this café?
 - 1 – Poor: The ambiance is uncomfortable or uninviting.
 - 2 – Fair: The ambiance is somewhat pleasant but could be improved.
 - 3 – Good: The ambiance is generally comfortable and enjoyable.
 - 4 – Excellent: The ambiance is highly comfortable and creates a very pleasant experience.
4. On a scale of 1 to 4, how would you rate the overall comfort at this café?
 - 1 – Poor: The overall comfort is unsatisfactory.
 - 2 – Fair: The overall comfort is acceptable but could be improved.
 - 3 – Good: The overall comfort is generally satisfactory and pleasant.
 - 4 – Excellent: The overall comfort is outstanding and enhances the entire experience.

Figure 5 Questionnaire for evaluating café conditions based on customer perceptions.

3. Results and Discussion

3.1 Light intensity measurements

Light intensity measurements were taken at several key locations in both cafés. At Threelogy Coffee, measurements were conducted in the indoor area, near the windows, and in the semi-outdoor space. In contrast, measurements at Zybrick Coffee and Cantina were taken in the indoor area, the semi-outdoor space, and near artificial lighting sources.

At Threelogy Coffee, light intensity measurements reveal significant variations between indoor and semi-outdoor areas. The indoor area has lux level ranging from 360 to 465 lux, while near the windows, the level reaches up to 3,460 lux. In the semi-outdoor areas, lux level varies from 723 to 1,535 lux, and in some parts of the semi-outdoor space, it can peak between 4,245 and 34,705 lux (Figure 6). These results indicate that Threelogy Coffee features very high lux levels, particularly in the semi-outdoor areas, which far exceed the standard lux levels for dining and workspaces. In contrast, Zybrick Coffee and Cantina exhibits lower light intensity compared to Threelogy Coffee. Measurements in the indoor area show lux level ranging from 65 to 70 lux, while in the semi-outdoor areas, it ranges from 240 to 670 lux (Figure 7). This lux level falls within the standard range for dining and workspaces. The lower lux level at Zybrick Coffee and Cantina is attributed to the minimal natural light entering the indoor area and the use of dark-colored materials, which reduce light reflectance.

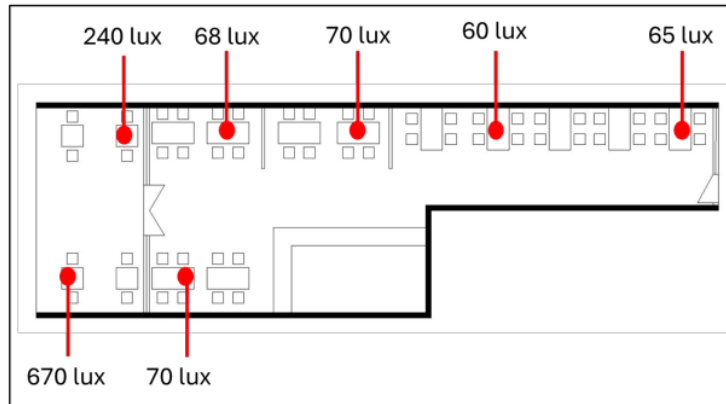


Figure 6 The light intensity measurements at Zybrick Coffee and Cantina.

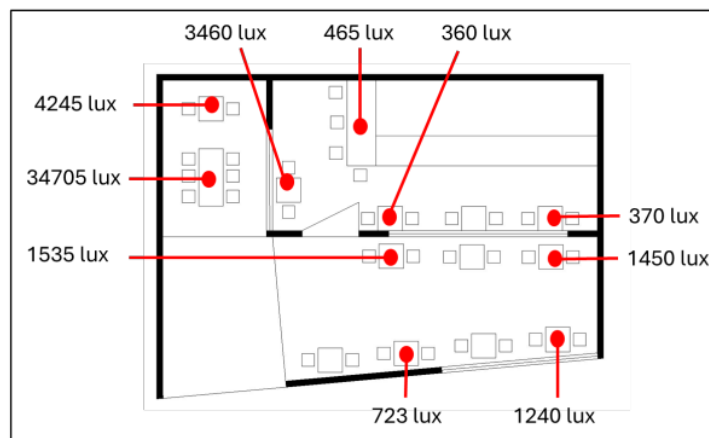


Figure 7 The light intensity measurements at Threelogy Coffee.

According to SNI standards, Threelogy Coffee has attained the required lux level for visual comfort, meeting the necessary criteria for both dining and working. However, the lux levels in the semi-outdoor area often exceed 1000 lux, which could lead to visual discomfort. In contrast, Zybrick Coffee and Cantina did not meet the visual comfort standards, as their lux levels fall significantly below the minimum required for these activities.

3.2 Questionnaire survey results

Questionnaire survey results (Figure 8) show that customers to Threelogy Coffee generally perceive the café as bright and visually appealing. About 75% of respondents rated the visual comfort as either 3 or 4 (good or excellent), while 70% rated the ambiance comfort as 3 (good). Overall, 80% of customers felt comfortable, scoring 3 or 4. These findings are consistent with the light intensity measurements, which reveal that Threelogy Coffee has exceptionally bright lighting.

In contrast, customers to Zybrick Coffee and Cantina often describe the café as relatively dim. Approximately 77.78% rated the lighting as 1 or 2 (poor or fair). Despite this, many still reported feeling comfortable, with 55.56% rating visual comfort as 3 or 4 (good or excellent), and 77.78% rating ambiance comfort as 3 or 4. These results suggest that, although Zybrick Coffee and Cantina has lower lighting levels, its ambiance still provides a high level of comfort for its guests and in general, 77.78% of the respondents felt comfortable.

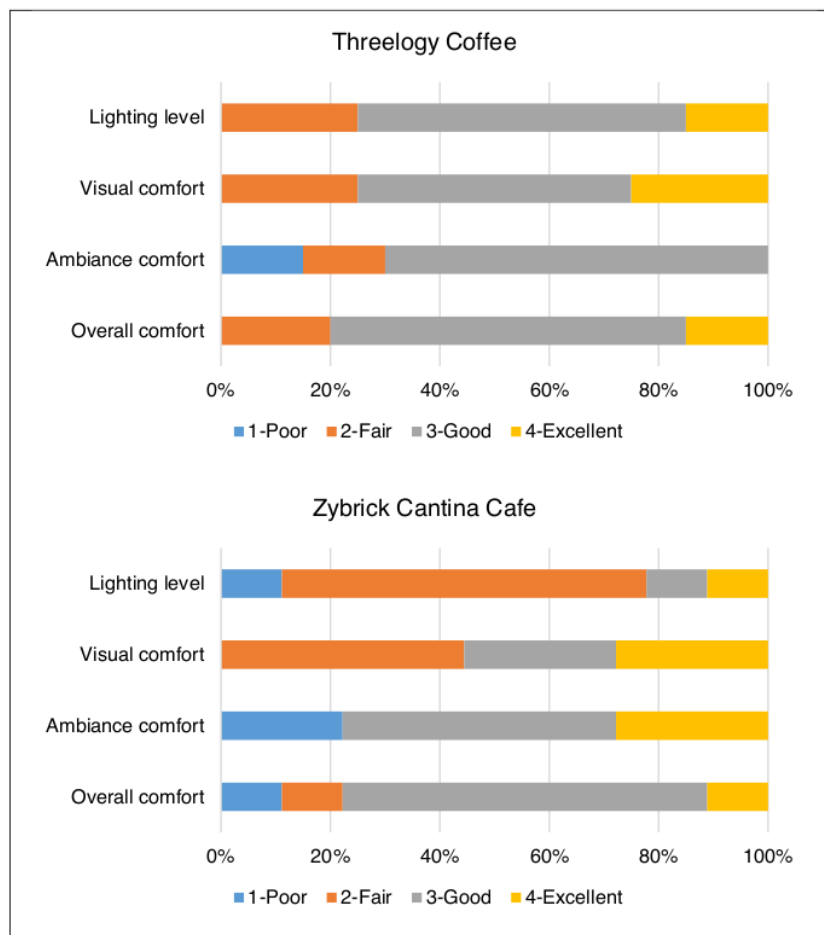


Figure 8 Questionnaire survey results for Threelogy Coffee and Zybrick Coffee and Cantina.

3.3 Discussions

The lighting at Threelogy Coffee is notably bright, especially in the semi-outdoor areas, with light intensity surpassing the standard levels for dining and workspaces. This high level of illumination is attributed to sunlight streaming through large windows and skylights, as well as reflections from white materials on the ceiling and walls. The bright lighting effectively draws customers' attention to the menu and food, enhancing visual comfort during meals [17]. However, excessively bright lighting can create a cold and monotonous atmosphere if customers spend extended periods in the café [23]. Research by Farooq et al. in [24] suggests that while very bright lighting provides good short-term visual comfort, it can lead to a sense of monotony and boredom over time. Questionnaire survey results indicate that customers at Threelogy Coffee are generally satisfied with the bright and visually comfortable lighting. However, the very bright lighting could impact long-term customer comfort, suggesting that lighting design should also consider the overall ambiance.

In contrast, the low lighting at Zybrick Coffee and Cantina is due to limited natural light and the use of dark-colored materials that reduce light reflectance. Although the light intensity falls below the ideal standards for dining and workspaces, the interior design—featuring exposed brick and dark wood—creates a warm and cozy atmosphere [21]. The artificial lighting used in the interior design contributes to a private and relaxing ambiance, particularly for customers who come to work or socialize. This aligns with findings that dim lighting can foster a relaxing and comfortable environment [25], [26]. Although customers at Zybrick Coffee and Cantina perceive the café as dim, they still find it comfortable due to its intimate atmosphere and interior design that fosters a sense of privacy. This suggests that a well-designed ambiance can compensate for deficiencies in light intensity, as previous research highlights that a well-crafted ambiance can enhance customer comfort even when lighting does not meet ideal standards [27], [28].

The research highlights a gap indicating that café lighting often falls short of SNI standards, yet this does not significantly impact the café's function. The findings suggest that the ambiance and overall comfort experienced by respondents at Zybrick Coffee and Cantina and Threelogy Coffee are not notably different. This can be attributed to the fact that while Threelogy Coffee's lux levels meet the requirements for dining and working, some areas exceed 1000 lux, which may cause visual discomfort. A café's comfortable atmosphere arises from the combination of lighting, interior design, color, and materials. The minimalist design and white surfaces in the ceilings and walls enhance light reflection and overall brightness. According to Mulyati in [23] and Farooq et al. in [24], excessively bright lighting can result in a cold, monotonous environment if customers find high light intensity uncomfortable. Furthermore, Trisna et al. in [29] found that customers prefer cafés that maintain the essence of a café, where the lighting is not as harsh as in office settings.

In contrast, Zybrick Coffee and Cantina use dark materials and artificial lighting to create a cozy, private atmosphere. This design strategy reduces light intensity but enhances intimacy, promoting customer comfort even if the lighting doesn't meet ideal standards [22]. According to AbuThahir et al. in [7], dim lighting contributes to a warm and private setting, increasing relaxation and comfort. Cafés with this type of lighting are more appealing to customers, as the warm ambiance stimulates their psycho-visual comfort [8], [10]. In this context, dim lighting fosters an environment conducive to socializing and working, suggesting that psycho-visual comfort can offset any deficiencies in visual comfort and light intensity.

Despite the differences in lighting intensity and ambiance between Zybrick Coffee and Cantina and Threelogy Coffee, respondents found both cafés to be comfortable. This suggests that effective café lighting should incorporate both bright and dim options to accommodate various activities, as noted by Putri in [11]. Vincent et al. in [30] further support this idea, stating that customers favor cafés that utilize natural materials and colors to foster a warm atmosphere, complemented by open areas with windows. As a result, this café offers two types of lighting: warm spotlighting and cooler daylight, which enables patrons to comfortably engage in activities like relaxing, reading, and working.

A café not only sells products; the atmosphere it provides is a crucial element that consumers look for in their experience [31]. Atsnawiyah et al. in [32] and Omar et al. in [33] suggest that a pleasant café environment can enhance the likelihood of customers returning, which can positively affect the café's revenue. However, this study is limited to examining the influence of café lighting on customer comfort perception. Future research could be broadened to explore how café lighting impacts customers' health, productivity, and likelihood of returning, as these are also vital for sustaining the café business.

4. Conclusion

This study investigates lighting in cafés as multifunctional spaces that accommodate dining, socializing, working, and both formal and informal meetings. Previous research has shown that café lighting often does not meet SNI standards, yet this shortfall does not significantly affect the space's functionality for visitors. However, the impact of these lighting deficiencies on customer experiences has not been extensively explored. This study seeks to address this gap by examining how varying lighting levels influence perceptions of comfort, offering valuable insights for café owners and designers aiming to create optimal dining environments.

Threeology Coffee and Zybrick Coffee and Cantina were selected as case studies to analyze the impact of lighting on customer perceptions and comfort. Threeology Coffee features exceptionally high lighting intensity, exceeding the standards for dining and workspaces, particularly in the semi-outdoor areas, due to sunlight entering through large windows and skylights, and the reflective properties of white walls and ceilings. In contrast, Zybrick Coffee and Cantina has lighting intensity below the ideal standard but creates a cozy and private atmosphere with artificial lighting and dark interior materials.

Survey results indicate that customers to Threeology Coffee are generally satisfied with the bright lighting, although there is potential for long-term monotony. Conversely, customers to Zybrick Coffee and Cantina appreciate the private ambiance, despite the dim lighting. These results emphasize that beyond just lighting, the overall ambiance of the café—comprising lighting, materials, and colors—significantly influences the quality of the customer experience.

To improve customer experience, cafés should focus on using varied lighting intensities along with thoughtful interior design. This indicates that effective café lighting should include both bright and dim options to support different activities. The café could provide two types of lighting: warm spotlighting and cooler daylight, allowing patrons to comfortably engage in activities such as relaxing, reading, and working.

Further research could explore how lighting and interior design impact various aspects of customer experience, including productivity, health, and overall satisfaction. By gaining a deeper understanding of how lighting, design, and customer comfort interact, cafés can better optimize the customer experience, enhancing both appeal and customer satisfaction.

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6. Conflict of Interest

The authors certify that the manuscript does not have a conflict of interest.

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The Impact of Café Lighting on Customer Comfort Perception: A Case Study of Threelogy Coffee and Zybrick Coffee and Cantina, Surabaya

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ABSTRACT

The evolution of cafés as multifunctional spaces for dining, socializing, and working has significantly influenced the standards for lighting. This study investigates the light intensity and customer comfort at Threelogy Coffee and Zybrick Coffee and Cantina, two cafés characterized by markedly different designs and lighting conditions. Field surveys and light intensity measurements were conducted to evaluate the lighting conditions at both locations, while questionnaires were used to assess visitor perceptions of comfort. At Threelogy Coffee, light intensity levels are notably high, with indoor measurements ranging from 360 to 465 lux and reaching up to 34,705 lux in semi-outdoor areas. This high level of illumination is attributed to natural sunlight and the reflective properties of white surfaces on ceilings and walls. Conversely, Zybrick Coffee and Cantina exhibits lower light intensity, with indoor levels between 65 and 70 lux and semi-outdoor areas ranging from 240 to 670 lux. This reduced illumination is due to limited natural light and the use of dark wall materials. Survey results reveal that customers to Threelogy Coffee generally express satisfaction with the bright lighting, although there is a potential risk of long-term monotony. In contrast, customers to Zybrick Coffee and Cantina report comfort despite the dim lighting, which is attributed to the private and intimate atmosphere fostered by the café's design. Both cafés exhibit comparable levels of overall comfort, highlighting the significance of atmospheric design elements, in addition to lighting, in creating a positive customer experience.

Keywords: atmosphere, cafés, customer comfort, lighting, visual comfort

1. Introduction

In the modern era, the role of cafes has evolved well beyond just being a place to eat. Today, cafes often serve as multifunctional spaces for socializing, working, studying, and hosting business or social meetings. [1], [2]. Along with this shift in function, café lighting standards have also undergone significant changes [3]. Lighting, which plays a crucial role in creating an appropriate and comfortable atmosphere, can directly impact customer comfort and productivity [4], [5].

Lighting, color, room decor, and aroma are critical factors that influence the atmosphere of a café and significantly impact its appeal and customer comfort. In addition to supporting various activities, lighting also plays a crucial role in shaping the overall ambiance of the space [6], [7]. Proper lighting enhances the functionality of the space and creates a pleasant atmosphere, which can improve the customer experience and attract more customers. In the context of cafés serving as both dining and working spaces, it is crucial to understand that these activities require different lighting levels. According to the SNI 6197:2020 standard on

energy conservation in lighting systems, cafés or dining areas should have lighting levels between 100 and 250 lux. In contrast, workspaces need higher lighting levels, around 350 lux [8].

Given that 80% of information is processed visually, lighting is essential in shaping a space's atmosphere [9]. As cafés evolve into multifunctional dining environments, research on appropriate lighting in cafés becomes increasingly important [10]. Adequate lighting not only enhances safety but also contributes to customer comfort and satisfaction [11]. While existing studies often explore the link between lighting design and customer behavior in cafés [6], [7], [9], few focus specifically on how varying lighting conditions impact customers' perceptions and comfort. This study seeks to assess how different lighting levels affect customer comfort at two cafés with distinctly different design characteristics and lighting conditions: Threelogy Coffee and Zybrick Coffee and Cantina.

2. Case Study

Threelogy Coffee and Zybrick Coffee and Cantina were selected as case studies because both serve similar functions as dining spots and gathering places for young people (Figure 1). Threelogy Coffee, located on Jl. Mojopahit, is near educational institutions such as Widya Mandala Catholic University and Santa Maria High School. Zybrick Coffee and Cantina is situated on Jl. Siwalankerto, close to Petra Christian University. Choosing these two cafés allows for a comprehensive evaluation of how lighting impacts customer comfort in environments that both cater to academic and young professional communities.

Although both cafés serve similar functions and target audiences as dining, social, and workspaces, their interior designs are markedly different in terms of natural lighting, color schemes, and materials. These design differences create a contrasting atmosphere between the two cafés [12]. Threelogy Coffee utilizes natural lighting through windows and skylights and features exposed concrete with bright colors such as white and gray (Figure 2). Threelogy Coffee exemplifies a modern café design that heavily relies on natural lighting. Its façade features numerous large windows that allow maximum sunlight to enter, while skylights further enhance the natural light, creating a bright and airy atmosphere throughout the day. The use of white walls and ceilings, along with exposed concrete, reflects light and improves overall illumination within the space. This design creates an impression of spaciousness, minimalism, and cleanliness while also imparting a sense of freshness. Beyond its visually appealing effect, it enhances customer comfort through its bright lighting.



Figure 1 (a) Building facades of Threelogy Coffee and (b) Zybrick Coffee and Cantina.

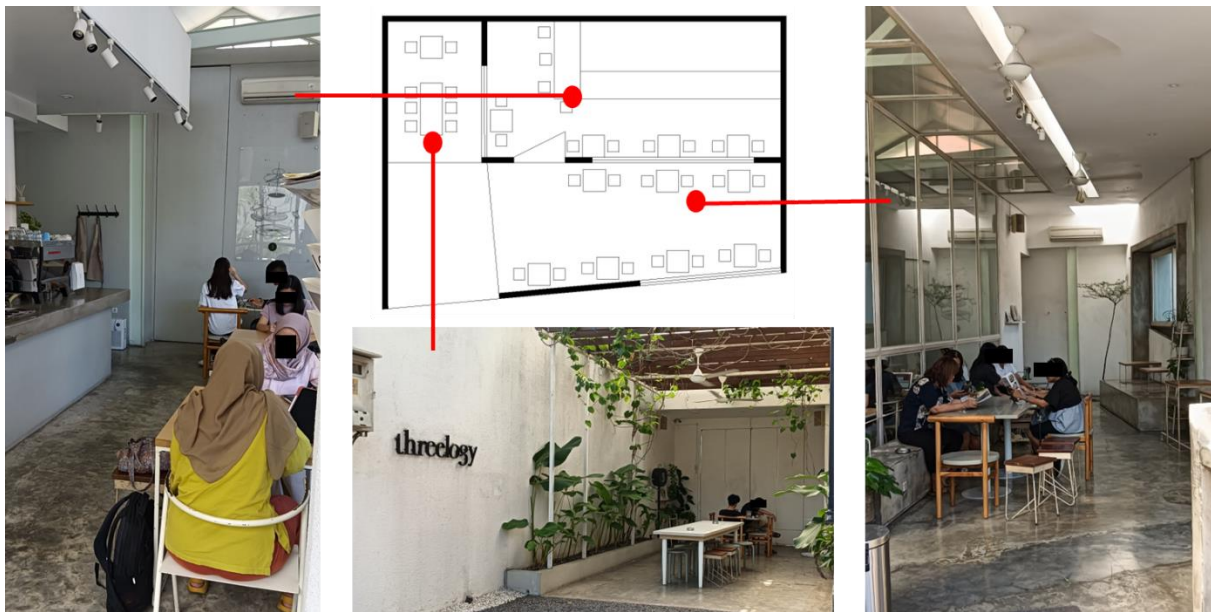


Figure 2 Atmosphere of Threelogy Coffee.



Figure 3 Atmosphere of the ground floor of Zybrick Coffee and Cantina.

Conversely, Zybrick Coffee and Cantina operates on a different principle. Relying primarily on artificial lighting, this café creates a more intimate and private atmosphere. Interior materials such as exposed brick and dark wood with a dark-colored ceiling are selected to impart a warm and luxurious feel, though this also limits natural light entry (Figure 3). Artificial lighting, strategically designed, aims to create a cozy ambiance that supports socializing and working. Although the lighting intensity might not meet the optimal standards for workspaces, the interior design offers a unique and attractive visual quality. This design creates a more private, luxurious, elegant, comfortable, and warm atmosphere [13], [14].

3. Method

This study employs field survey and questionnaire to evaluate lighting and comfort at Threelogy Coffee and Zybrick Coffee and Cantina. The field survey involves measuring light intensity and documenting the lighting conditions in both cafés. As Threelogy Coffee utilizes daylighting, the measurements are taken at noon, when sunlight is at its peak, to ensure accurate data on natural illumination. A lux meter is used to measure light intensity at several strategic points within the cafés, including dining tables, semi-outdoor areas, and near windows. The light intensity data, measured in lux, were analyzed to determine if the lighting meets the standards for dining and workspaces. This assessment aims to understand how lighting influences the customer experience across different areas of the cafés.

In addition to the field survey, questionnaires are distributed to customers present at the cafés during the measurements. The questionnaires are designed to gather data on customers' perceptions of lighting and café comfort. They include questions about lighting levels, visual comfort, atmospheric comfort, and overall satisfaction. Respondents rate their experience on a scale of 1 to 4, where 1 indicates dissatisfaction and 4 indicates maximum satisfaction (Figure 4). The questionnaire data are analyzed to identify patterns and trends in customer perceptions of lighting and ambiance at each café.

The field survey at Threelogy Coffee was conducted on August 31, with questionnaires distributed to 20 customers present at the café between 11:00 AM and 2:00 PM. Similarly, the field survey at Zybrick Coffee and Cantina took place on August 3, where questionnaires were given to 18 customers present during the same hours. Although Zybrick Coffee and Cantina has two floors designated for dining, the case study focused solely on the ground floor, as the second floor was closed and not in use at the time of the survey and questionnaire administration. The light intensity measurements and questionnaire results from both cafés will be compared and analyzed to assess visitor perceptions of lighting and comfort in each café.

Café Condition Assessment Questionnaire Based on Customer Perception

Instructions: Please rate the following aspects of the café based on your experience, using a scale of 1 to 4. Your responses will help us understand and improve the café environment.

1. On a scale of 1 to 4, how would you rate the lighting level at this café?
 - 1 – Poor: The lighting is inadequate and uncomfortable.
 - 2 – Fair: The lighting is somewhat adequate but could be improved.
 - 3 – Good: The lighting is sufficient and generally comfortable.
 - 4 – Excellent: The lighting is optimal and enhances the overall experience.
2. On a scale of 1 to 4, how would you rate the visual comfort at this café?
 - 1 – Poor: The visual comfort is uncomfortable or bothersome.
 - 2 – Fair: The visual comfort is somewhat adequate but could be improved.
 - 3 – Good: The visual comfort is generally pleasant and suitable.
 - 4 – Excellent: The visual comfort is optimal and enhances the overall experience.
3. On a scale of 1 to 4, how would you rate the comfort of the ambiance at this café?
 - 1 – Poor: The ambiance is uncomfortable or uninviting.
 - 2 – Fair: The ambiance is somewhat pleasant but could be improved.
 - 3 – Good: The ambiance is generally comfortable and enjoyable.
 - 4 – Excellent: The ambiance is highly comfortable and creates a very pleasant experience.
4. On a scale of 1 to 4, how would you rate the overall comfort at this café?
 - 1 – Poor: The overall comfort is unsatisfactory.
 - 2 – Fair: The overall comfort is acceptable but could be improved.
 - 3 – Good: The overall comfort is generally satisfactory and pleasant.
 - 4 – Excellent: The overall comfort is outstanding and enhances the entire experience.

Figure 4 Questionnaire for evaluating café conditions based on customer perceptions.

4. Results and Discussion

4.1 Light intensity measurements

Light intensity measurements were taken at several key locations in both cafés. At Threelogy Coffee, measurements were conducted in the indoor area, near the windows, and in the semi-outdoor space. In contrast, measurements at Zybrick Coffee and Cantina were taken in the indoor area, the semi-outdoor space, and near artificial lighting sources.

At Threelogy Coffee, light intensity measurements reveal significant variations between indoor and semi-outdoor areas. The indoor area has light intensity ranging from 360 to 465 lux, while near the windows, the intensity reaches up to 3,460 lux. In the semi-outdoor areas, light intensity varies from 723 to 1,535 lux, and in some parts of the semi-outdoor space, it can peak between 4,245 and 34,705 lux (Figure 5). These results indicate that Threelogy Coffee features very high lighting levels, particularly in the semi-outdoor areas, which far exceed the standard lighting levels for dining and workspaces.

In contrast, Zybrick Coffee and Cantina exhibits lower light intensity compared to Threelogy Coffee. Measurements in the indoor area show light intensity ranging from 65 to 70 lux, while in the semi-outdoor areas, it ranges from 240 to 670 lux (Figure 6). This light intensity falls within the standard range for dining and workspaces. The lower light intensity at Zybrick Coffee and Cantina is attributed to the minimal natural light entering the indoor area and the use of dark-colored materials, which reduce light reflectance.

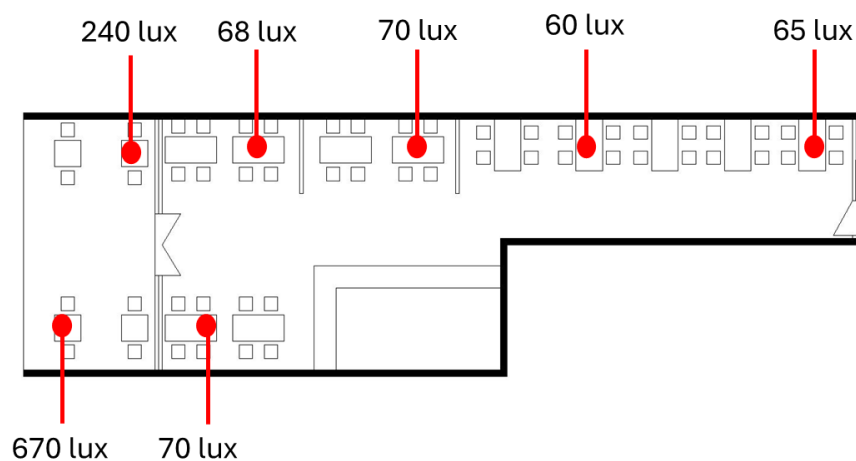


Figure 5 The light intensity measurements at Zybrick Coffee and Cantina.

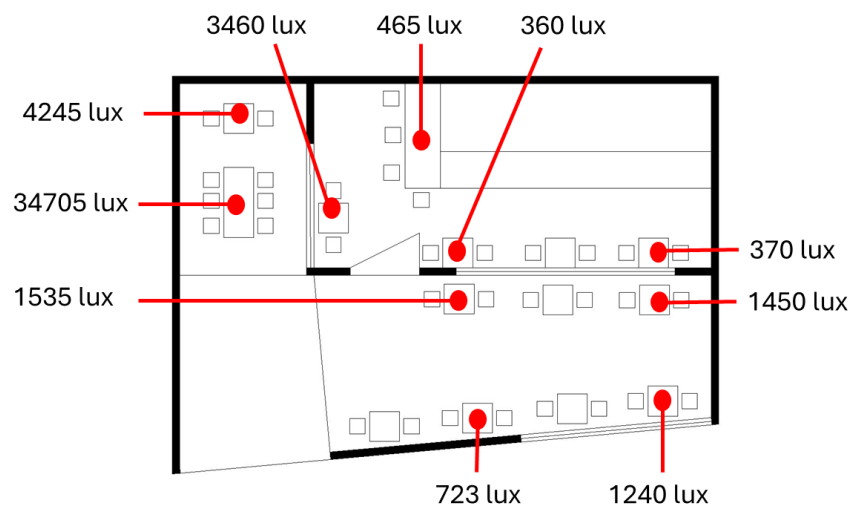


Figure 6 The light intensity measurements at Threelogy Coffee.

4.2 Questionnaire survey results

Questionnaire survey results (Figure 7) show that customers to Threelogy Coffee generally perceive the café as bright and visually appealing. About 75% of respondents rated the visual comfort as either 3 or 4 (good or excellent), while 70% rated the ambiance comfort as 3 (good). Overall, 80% of customers felt comfortable, scoring 3 or 4. These findings are consistent with the light intensity measurements, which reveal that Threelogy Coffee has exceptionally bright lighting.

In contrast, customers to Zybrick Coffee and Cantina often describe the café as relatively dim. Approximately 77.78% rated the lighting as 1 or 2 (poor or fair). Despite this, many still reported feeling comfortable, with 55.56% rating visual comfort as 3 or 4 (good or excellent), and 77.78% rating ambiance comfort as 3 or 4. These results suggest that, although Zybrick Coffee and Cantina has lower lighting levels, its ambiance still provides a high level of comfort for its guests.

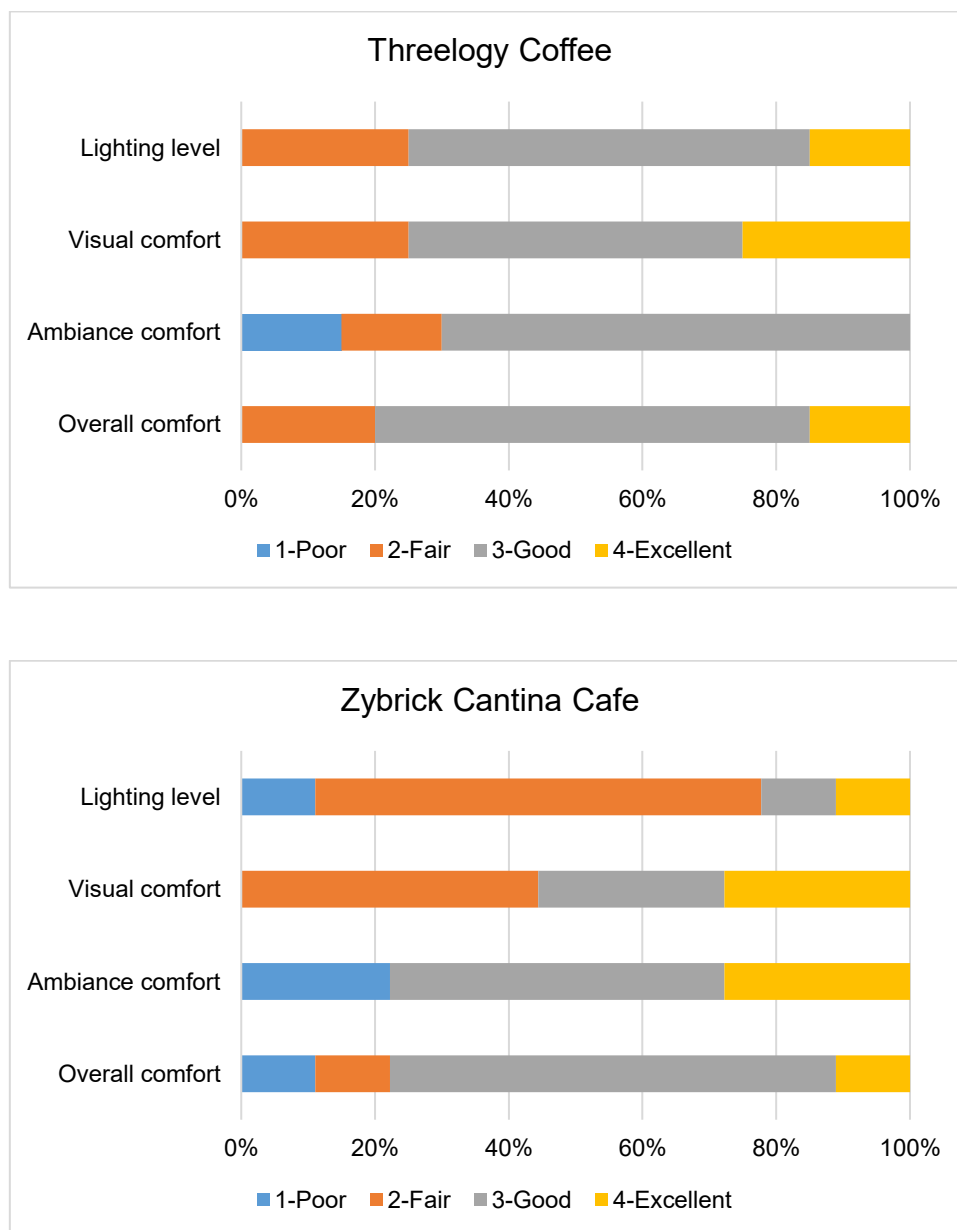


Figure 7 Questionnaire survey results for Threelogy Coffee and Zybrick Coffee and Cantina.

4.3 Discussions

The lighting at Threelogy Coffee is notably bright, especially in the semi-outdoor areas, with light intensity surpassing the standard levels for dining and workspaces. This high level of illumination is attributed to sunlight streaming through large windows and skylights, as well as reflections from white materials on the ceiling and walls. The bright lighting effectively draws customers' attention to the menu and food, enhancing visual comfort during meals [15]. However, excessively bright lighting can create a cold and monotonous atmosphere if customers spend extended periods in the café [14]. Research by Farooq et al. in [16] suggests that while very bright lighting provides good short-term visual comfort, it can lead to a sense of monotony and boredom over time.

In contrast, the low lighting at Zybrick Coffee and Cantina is due to limited natural light and the use of dark-colored materials that reduce light reflectance. Although the light intensity falls below the ideal standards for dining and workspaces, the interior design—featuring exposed brick and dark wood—creates a warm and cozy atmosphere [12]. The artificial lighting used in the interior design contributes to a private and relaxing ambiance, particularly for customers who come to work or socialize. This aligns with findings that dim lighting can foster a relaxing and comfortable environment [17], [18].

Questionnaire survey results indicate that customers at Threelogy Coffee are generally satisfied with the bright and visually comfortable lighting. However, the very bright lighting could impact long-term customer comfort, suggesting that lighting design should also consider the overall ambiance. On the other hand, although customers at Zybrick Coffee and Cantina perceive the café as dim, they still find it comfortable due to its intimate atmosphere and interior design that fosters a sense of privacy. This suggests that a well-designed ambiance can compensate for deficiencies in light intensity, as previous research highlights that a well-crafted ambiance can enhance customer comfort even when lighting does not meet ideal standards [19], [20].

The interior design of a café plays a crucial role in shaping how lighting affects the customer experience. A café's comfortable ambiance results from the interplay between lighting, interior design, color, and materials. While very bright lighting can capture attention, it may become monotonous if customers stay for extended periods. At Threelogy Coffee, the minimalist design and white colors on the ceilings and walls enhance light reflection and overall illumination. However, very bright lighting can create a cold and monotonous atmosphere if customers are uncomfortable with high light intensity [14].

Conversely, dim lighting can create a warm and private atmosphere, enhancing relaxation and comfort [7]. Research by Atsnawiyah et al. in [21] and Omar et al. in [22] indicate that a pleasant café environment can increase customers' likelihood of returning, which, in turn, can positively impact the café's revenue. Zybrick Coffee and Cantina employs dark materials and artificial lighting to create a cozy and private ambiance. This design approach limits light intensity but fosters an intimate atmosphere, which supports customer comfort even though the lighting may not meet ideal standards [13]. In this context, dim lighting provides a conducive environment for socializing and working, demonstrating that effective interior design can compensate for shortcomings in light intensity.

5. Conclusion and Future Research

This study explores lighting in cafés as multifunctional spaces catering to dining, socializing, working, and formal or informal meetings. Threelogy Coffee and Zybrick Coffee and Cantina were selected as case studies to analyze the impact of lighting on customer perceptions and comfort. Threelogy Coffee features exceptionally high lighting intensity, exceeding the standards for dining and workspaces, particularly in the semi-outdoor areas, due to sunlight entering through large windows and skylights, and the reflective properties of white walls and ceilings. In contrast, Zybrick Coffee and Cantina has lighting intensity below the ideal standard but creates a cozy and private atmosphere with artificial lighting and dark interior materials.

Survey results indicate that customers to Threelogy Coffee are generally satisfied with the bright lighting, although there is potential for long-term monotony. Conversely, customers to Zybrick Coffee and Cantina appreciate the private ambiance, despite the dim lighting. These results emphasize that beyond just lighting, the overall ambiance of the café—comprising lighting, materials, and colors—significantly influences the quality of the customer experience.

To enhance customer experience, cafés should consider varying lighting intensities and interior design. For cafés with very bright lighting, such as Threelogy Coffee, incorporating design elements that create atmospheric variation could help mitigate potential monotony. Conversely, cafés like Zybrick Coffee and Cantina, which rely on dim lighting, might introduce brighter lighting elements in specific areas to support activities requiring better illumination while maintaining a cozy and private ambiance.

Further research could explore how lighting and interior design impact various aspects of customer experience, including productivity, health, and overall satisfaction. By gaining a deeper understanding of how lighting, design, and customer comfort interact, cafés can better optimize the customer experience, enhancing both appeal and customer satisfaction.

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8. Conflict of Interest

The authors certify that the manuscript does not have a conflict of interest.

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a	Research background explained?	1	2	3	4	5	Weakness: The introduction does not clearly present the research question or hypothesis, making it unclear why the study was conducted. The context of the lighting problem in cafés is provided but not linked strongly enough to the study's aims. Correction: Clearly define the research question or hypothesis in the introduction. For example, specify whether the study aims to assess how varying lighting levels affect customer perceptions of comfort in different café settings. Provide a stronger rationale for why this issue is relevant, especially in the context of evolving café functions and customer expectations.
b	Research purpose explained?	1	2	3	4	5	
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b	Knowledge as the basis of research demonstrated?	1	2	3	4	5	
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5	Findings (Weightage: 15%)						
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The Impact of Café Lighting on Customer Comfort Perception: A Case Study of Threelogy Coffee and Zybrick Coffee and Cantina, Surabaya

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ABSTRACT

The evolution of cafés as multifunctional spaces for dining, socializing, and working has significantly influenced the standards for lighting. Previous research has shown that while café lighting frequently falls short of SNI standards, this does not impede the space's functionality, and the effects of these deficiencies on customer experiences remain largely unexplored. This study investigates the light intensity and customer comfort at Threelogy Coffee and Zybrick Coffee and Cantina, two cafés characterized by markedly different designs and lighting conditions. Field surveys and light intensity measurements using lux meter were conducted to evaluate the lighting conditions at both locations, while questionnaires were used to assess visitor perceptions of comfort. At Threelogy Coffee, light intensity levels are notably high, with indoor measurements ranging from 360 to 465 lux and reaching up to 34,705 lux in semi-outdoor areas. Conversely, Zybrick Coffee and Cantina exhibits lower light intensity, with indoor levels between 65 and 70 lux and semi-outdoor areas ranging from 240 to 670 lux. Survey results reveal that customers to Threelogy Coffee generally express satisfaction with the bright lighting, although there is a potential risk of long-term monotony. Meanwhile, customers to Zybrick Coffee and Cantina report comfort despite the dim lighting, which is attributed to the private and intimate atmosphere fostered by the café's design. Both cafés exhibit comparable levels of overall comfort, highlighting the significance of atmospheric design elements, in addition to lighting, in creating a positive customer experience. These findings indicate that cafés should adopt a range of lighting intensities along with careful interior design, utilizing both bright and dim options to cater to various activities. This could include providing warm spotlighting and cooler daylight, allowing patrons to comfortably relax, read, and work.

Keywords: atmosphere, cafés, customer comfort, lighting, visual comfort

7

1. Introduction

In the modern era, the role of cafes has evolved well beyond just being a place to eat. Today, cafes often serve as multifunctional spaces for socializing, working, studying, and hosting business or social meetings. [1], [2]. Along with this shift in function, café lighting standards have also undergone significant changes [3]. Lighting, which plays a crucial role in creating an appropriate and comfortable atmosphere, can directly impact customer comfort and productivity [4], [5].

Lighting, color, room decor, and aroma are critical factors that influence the atmosphere of a café and significantly impact its appeal and customer comfort. In addition to supporting various activities, lighting also plays a crucial role in shaping the overall ambiance of the space [6], [7]. Light intensity, color temperature,

16

and light distribution significantly influence visitor activities in coffee shops, as observed through both perception and field studies. Higher light intensity correlates with more complex activities, such as working, studying, and meetings, while lower intensity is associated with simpler social interactions. While color temperature impacts how visitors engage with the environment; warmer light colors encourage relaxation and casual conversations, whereas cooler, white light supports both socializing and more focused tasks [8]. AbuThahir et al. [7] mentioned that dimmed lighting creates an intimate atmosphere, but adequate brightness is necessary for enhancing visual comfort, as proper lighting significantly enhances customer impressions, revisit intentions, and perceptions of service quality in cafés. The integration of natural and artificial lighting creates a tranquil and inviting atmosphere, significantly influencing visual comfort. Factors that affect this comfort include lighting conditions, which can impact mood and overall well-being; the interplay of light and color, which helps establish specific atmospheres; and the presence of excessive sunlight, which can negatively affect user comfort [9]. Wardono et al. [10] recommends achieving visual comfort by establishing a harmonious ambiance and color scheme that influences people's emotions. However, the influx of daylight in a café should be noted, sometimes it can be too intense, as excessive brightness may disrupt the overall atmosphere. According to Putri et al. [11], the design of lighting in cafés must consider both visual comfort and psycho-visual comfort. Visual comfort is influenced by the intensity of light, which should be adequate for the activities being performed. Psycho-visual comfort, on the other hand, is affected by the stimuli from the surrounding lighting conditions that influence visitors' visual perceptions, emotions, and behaviors. Psycho-visual comfort refers to how the physical environment creates visual perceptions, emotions, and human behaviors. Proper lighting enhances the functionality of the space and creates a pleasant atmosphere, which can improve the customer experience and attract more customers.

In the context of cafés serving as both dining and working spaces, it is crucial to understand that these activities require different lighting levels. According to the SNI 6197:2020 standard on energy conservation in lighting systems, cafés or dining areas should have lighting levels between 100 and 250 lux. In contrast, workspaces need higher lighting levels, around 350 lux [12]. However, several studies on cafe lighting reveal that light intensity often falls short of SNI standards. Maggiet T et al. [13] noted that many restaurants overlook the functional aspect of lighting. It appears that the lighting standards in these spaces are not aligned with the needs of visitors or staff. Research at Starbucks Coffee in Cambridge City Square showed that light intensity levels do not fully comply with visual comfort standards as per SNI [14]. Similarly, Novrial et al. [8] measured light intensity at Tamoe Coffee and Resto and Makecents Coffee and Space in Medan, finding that Tamoe Coffee and Resto had a range of 100 to 155 lux, while Makecents Coffee and Space ranged from 80 to 200 lux. Putri [15] reported an average light intensity of just 58.21 lux at Caloria Café in Surabaya. In another study, Yahya et al. [16] measured light intensity at over 100 points in Good Dank Coffee Shop in Malang at various times and found most measurements were below 250 lux. Additionally, Ahda et al. [17] indicated that five out of six measurement points at Starbucks Jatiuwung in Banten registered below 250 lux. At Tanatap Ring Garden Coffee Shop in Ampera Jakarta, light intensity measurements across three areas showed that only two areas met SNI standards, while the third area fell below 250 lux. This was due to the latter area being designed for a relaxing atmosphere, while the other two were intended for work activities.

Given that 80% of information is processed visually, lighting is essential in shaping a space's atmosphere [18]. As cafés evolve into multifunctional dining environments which require different lux level to accomodate various activities, research on appropriate lighting in cafés becomes increasingly important [19]. Adequate lighting not only enhances safety but also contributes to customer comfort and satisfaction [20]. While existing studies often explore the link between lighting design and customer behavior in cafés [6], [7], few focus specifically on how varying lighting conditions impact customers' perceptions and comfort. Although previous research has indicated that café lighting often falls below SNI standards, this discrepancy does not hinder the space's functionality as a place for visitors' activities at the coffee shop and the implications of these deficiencies on customer experiences have not been thoroughly investigated [8]. This study aims to fill this gap by examining how different lighting levels influence perceptions of comfort, providing valuable insights for café owners and designers seeking to create optimal dining environments.

2. Method

2.1 Case studies

This study seeks to assess how different lighting levels affect customer comfort at two cafés with distinctly different design characteristics and lighting conditions: Threelogy Coffee and Zybrick Coffee and Cantina. Threelogy Coffee and Zybrick Coffee and Cantina were selected as case studies because both serve similar functions as dining spots and gathering places for young people (Figure 1). Threelogy Coffee, located on Mojopahit street, is near educational institutions such as Widya Mandala Catholic University and Santa Maria High School. Zybrick Coffee and Cantina is situated on Siwalankerto street, close to Petra Christian University. Choosing these two cafés allows for a comprehensive evaluation of how lighting impacts customer comfort in environments that both cater to academic and young professional communities.



Figure 1 (a) Building facades of Threelogy Coffee and (b) Zybrick Coffee and Cantina.

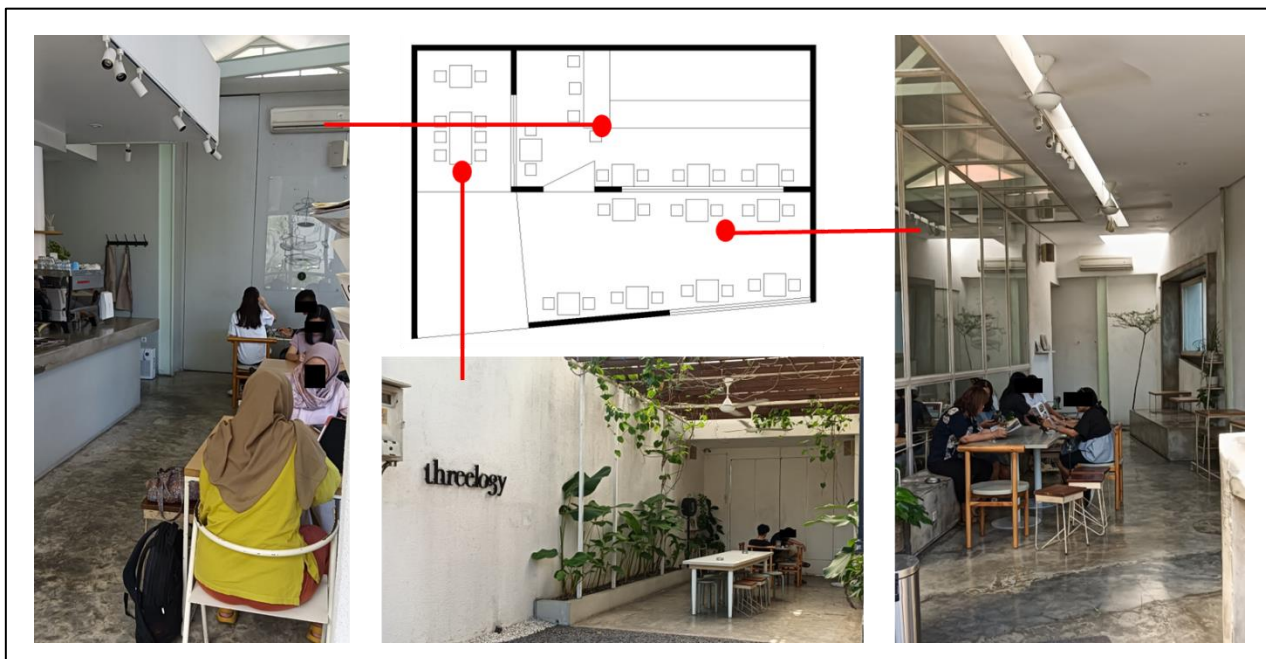


Figure 2 Atmosphere of Threelogy Coffee.

Although both cafés serve similar functions and target audiences as dining, social, and workspaces, their interior designs are markedly different in terms of natural lighting, color schemes, and materials. These design differences create a contrasting atmosphere between the two cafés [21]. Threelogy Coffee utilizes natural lighting through windows and skylights and features exposed concrete with bright colors such as white and gray (Figure 2). Threelogy Coffee exemplifies a modern café design that heavily relies on natural lighting. Its façade features numerous large windows that allow maximum sunlight to enter, while skylights further enhance the natural light, creating a bright and airy atmosphere throughout the day. The use of white walls and ceilings,

1 along with exposed concrete, reflects light and improves overall illumination within the space. This design
 2 creates an impression of spaciousness, minimalism, and cleanliness while also imparting a sense of freshness.
 3 Beyond its visually appealing effect, it enhances customer comfort through its bright lighting.



Figure 3 Atmosphere of the ground floor of Zybrick Coffee and Cantina.

6 Conversely, Zybrick Coffee and Cantina operates on a different principle. Relying primarily on artificial
 7 lighting, this café creates a more intimate and private atmosphere. Interior materials such as exposed brick and
 8 dark wood with a dark-colored ceiling are selected to impart a warm and luxurious feel, though this also limits
 9 natural light entry (Figure 3). Artificial lighting, strategically designed, aims to create a cozy ambiance that
 10 supports socializing and working. Although the lighting intensity might not meet the optimal standards for
 11 workspaces, the interior design offers a unique and attractive visual quality. This design creates a more private,
 12 luxurious, elegant, comfortable, and warm atmosphere [22], [23].

13 2.1 Field measurement and questionnaire survey

14 This study employs field survey and questionnaire to evaluate lighting and comfort at Threelogy Coffee and
 15 Zybrick Coffee and Cantina. The field survey involves measuring light intensity and documenting the lighting
 16 conditions in both cafés. To capture accurate data on natural illumination, measurements at Threelogy Coffee
 17 were conducted at noon when sunlight is most intense, specifically on August 31, between 11:00 AM and 2:00
 18 PM. Similarly, the survey at Zybrick Coffee and Cantina was carried out on August 3, during the same time
 19 frame.

20 A lux meter was employed to measure light intensity at key locations throughout the cafés, including dining
 21 tables, semi-outdoor areas, and near windows (Figure 4). The lux meter was placed directly on the tables.
 22 Although Zybrick Coffee and Cantina has two floors available for dining, this study focused solely on the
 23 ground floor due to the second floor being closed at the time of the survey and questionnaire administration.
 24 The collected light intensity data, measured in lux, were analyzed to determine whether the lighting meets the
 25 standards for dining and workspaces as defined by SNI.

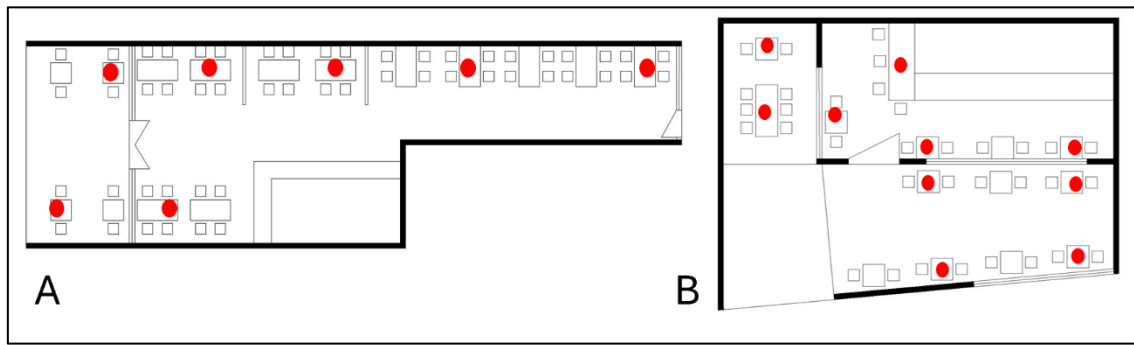


Figure 4 Measurement points at Zybrick Coffee and Cantina (a) and Threelogy Coffee (b).

In addition to the field survey, questionnaires are distributed to customers present at the cafés during the field survey. The questionnaires are designed to gather data on customers' perceptions of lighting and café comfort. They include questions about lighting levels, visual comfort, atmospheric comfort, and overall satisfaction. Respondents rate their experience on a scale of 1 to 4, where 1 indicates dissatisfaction and 4 indicates maximum satisfaction (Figure 5).

On August 31, during the survey at Threelogy Coffee, questionnaires were given to 20 customers between 11:00 AM and 2:00 PM. At Zybrick Coffee and Cantina, on August 3, 18 customers were surveyed during the same time frame. The collected questionnaire data will be analyzed to identify patterns and trends in customer perceptions of lighting and ambiance at each café. The findings from both the light intensity measurements and the questionnaire responses will be compared and analyzed to evaluate visitor perceptions of lighting and comfort in each location.

Café Condition Assessment Questionnaire Based on Customer Perception

Instructions: Please rate the following aspects of the café based on your experience, using a scale of 1 to 4. Your responses will help us understand and improve the café environment.

1. On a scale of 1 to 4, how would you rate the lighting level at this café?
 - 1 – Poor: The lighting is inadequate and uncomfortable.
 - 2 – Fair: The lighting is somewhat adequate but could be improved.
 - 3 – Good: The lighting is sufficient and generally comfortable.
 - 4 – Excellent: The lighting is optimal and enhances the overall experience.
2. On a scale of 1 to 4, how would you rate the visual comfort at this café?
 - 1 – Poor: The visual comfort is uncomfortable or bothersome.
 - 2 – Fair: The visual comfort is somewhat adequate but could be improved.
 - 3 – Good: The visual comfort is generally pleasant and suitable.
 - 4 – Excellent: The visual comfort is optimal and enhances the overall experience.
3. On a scale of 1 to 4, how would you rate the comfort of the ambiance at this café?
 - 1 – Poor: The ambiance is uncomfortable or uninviting.
 - 2 – Fair: The ambiance is somewhat pleasant but could be improved.
 - 3 – Good: The ambiance is generally comfortable and enjoyable.
 - 4 – Excellent: The ambiance is highly comfortable and creates a very pleasant experience.
4. On a scale of 1 to 4, how would you rate the overall comfort at this café?
 - 1 – Poor: The overall comfort is unsatisfactory.
 - 2 – Fair: The overall comfort is acceptable but could be improved.
 - 3 – Good: The overall comfort is generally satisfactory and pleasant.
 - 4 – Excellent: The overall comfort is outstanding and enhances the entire experience.

Figure 5 Questionnaire for evaluating café conditions based on customer perceptions.

3. Results and Discussion

3.1 Light intensity measurements

Light intensity measurements were taken at several key locations in both cafés. At Threelogy Coffee, measurements were conducted in the indoor area, near the windows, and in the semi-outdoor space. In contrast, measurements at Zybrick Coffee and Cantina were taken in the indoor area, the semi-outdoor space, and near artificial lighting sources.

At Threelogy Coffee, light intensity measurements reveal significant variations between indoor and semi-outdoor areas. The indoor area has lux level ranging from 360 to 465 lux, while near the windows, the level reaches up to 3,460 lux. In the semi-outdoor areas, lux level varies from 723 to 1,535 lux, and in some parts of the semi-outdoor space, it can peak between 4,245 and 34,705 lux (Figure 6). These results indicate that Threelogy Coffee features very high lux levels, particularly in the semi-outdoor areas, which far exceed the standard lux levels for dining and workspaces. In contrast, Zybrick Coffee and Cantina exhibits lower light intensity compared to Threelogy Coffee. Measurements in the indoor area show lux level ranging from 65 to 70 lux, while in the semi-outdoor areas, it ranges from 240 to 670 lux (Figure 7). This lux level falls within the standard range for dining and workspaces. The lower lux level at Zybrick Coffee and Cantina is attributed to the minimal natural light entering the indoor area and the use of dark-colored materials, which reduce light reflectance.

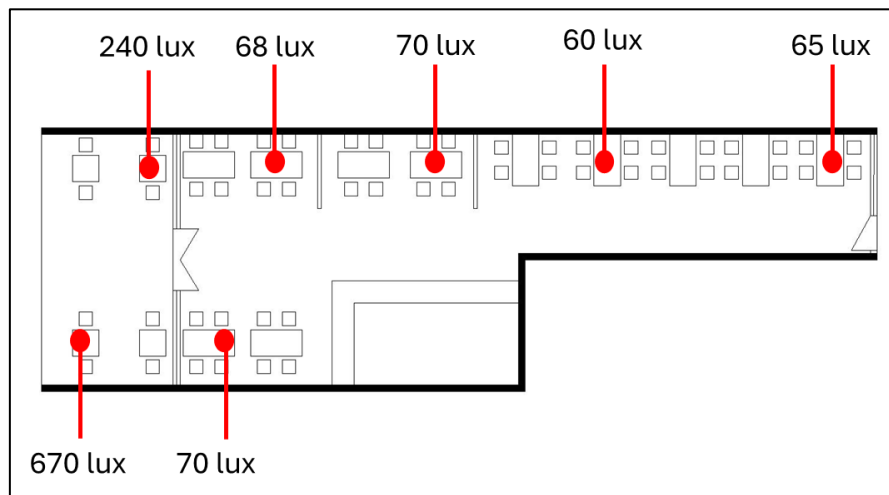


Figure 6 The light intensity measurements at Zybrick Coffee and Cantina.

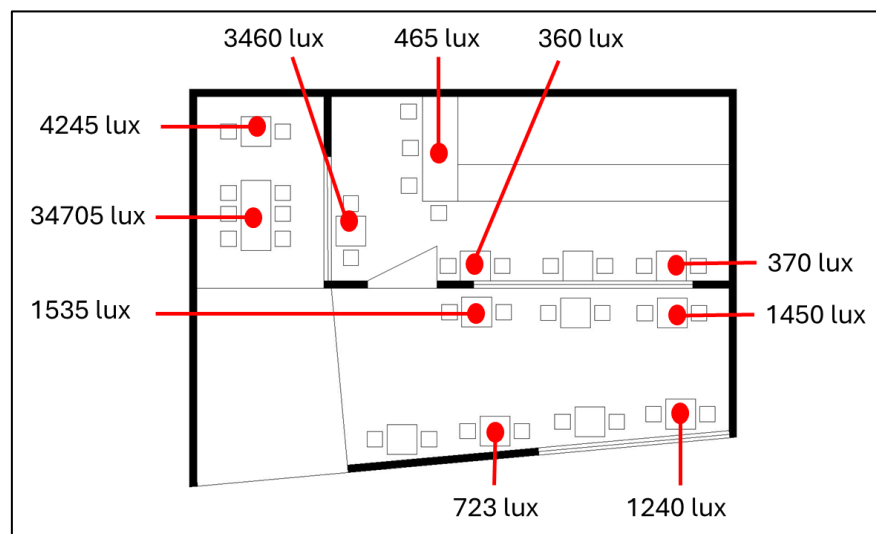


Figure 7 The light intensity measurements at Threelogy Coffee.

According to SNI standards, Threelogy Coffee has attained the required lux level for visual comfort, meeting the necessary criteria for both dining and working. However, the lux levels in the semi-outdoor area often exceed 1000 lux, which could lead to visual discomfort. In contrast, Zybrick Coffee and Cantina did not meet the visual comfort standards, as their lux levels fall significantly below the minimum required for these activities.

3.2 Questionnaire survey results

Questionnaire survey results (Figure 8) show that customers to Threelogy Coffee generally perceive the café as bright and visually appealing. About 75% of respondents rated the visual comfort as either 3 or 4 (good or excellent), while 70% rated the ambience comfort as 3 (good). Overall, 80% of customers felt comfortable, scoring 3 or 4. These findings are consistent with the light intensity measurements, which reveal that Threelogy Coffee has exceptionally bright lighting.

In contrast, customers to Zybrick Coffee and Cantina often describe the café as relatively dim. Approximately 77.78% rated the lighting as 1 or 2 (poor or fair). Despite this, many still reported feeling comfortable, with 55.56% rating visual comfort as 3 or 4 (good or excellent), and 77.78% rating ambience comfort as 3 or 4. These results suggest that, although Zybrick Coffee and Cantina has lower lighting levels, its ambience still provides a high level of comfort for its guests and in general, 77.78% of the respondents felt comfortable.

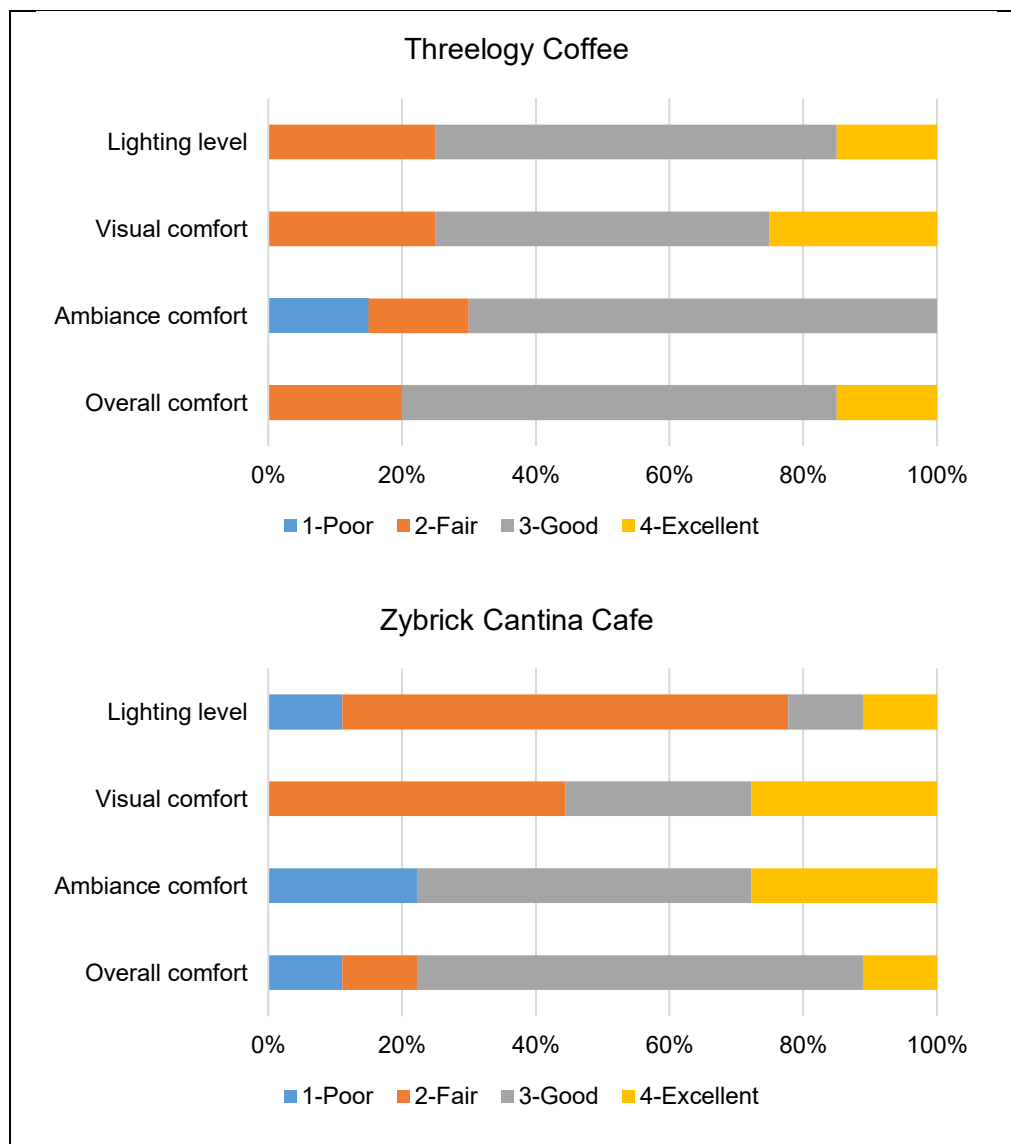


Figure 8 Questionnaire survey results for Threelogy Coffee and Zybrick Coffee and Cantina.

3.3 Discussions

The lighting at Threelogy Coffee is notably bright, especially in the semi-outdoor areas, with light intensity surpassing the standard levels for dining and workspaces. This high level of illumination is attributed to sunlight streaming through large windows and skylights, as well as reflections from white materials on the ceiling and walls. The bright lighting effectively draws customers' attention to the menu and food, enhancing visual comfort during meals [17]. However, excessively bright lighting can create a cold and monotonous atmosphere if customers spend extended periods in the café [23]. Research by Farooq et al. in [24] suggests that while very bright lighting provides good short-term visual comfort, it can lead to a sense of monotony and boredom over time. Questionnaire survey results indicate that customers at Threelogy Coffee are generally satisfied with the bright and visually comfortable lighting. However, the very bright lighting could impact long-term customer comfort, suggesting that lighting design should also consider the overall ambiance.

In contrast, the low lighting at Zybrick Coffee and Cantina is due to limited natural light and the use of dark-colored materials that reduce light reflectance. Although the light intensity falls below the ideal standards for dining and workspaces, the interior design—featuring exposed brick and dark wood—creates a warm and cozy atmosphere [21]. The artificial lighting used in the interior design contributes to a private and relaxing ambiance, particularly for customers who come to work or socialize. This aligns with findings that dim lighting can foster a relaxing and comfortable environment [25], [26]. Although customers at Zybrick Coffee and Cantina perceive the café as dim, they still find it comfortable due to its intimate atmosphere and interior design that fosters a sense of privacy. This suggests that a well-designed ambiance can compensate for deficiencies in light intensity, as previous research highlights that a well-crafted ambiance can enhance customer comfort even when lighting does not meet ideal standards [27], [28].

The research highlights a gap indicating that café lighting often falls short of SNI standards, yet this does not significantly impact the café's function. The findings suggest that the ambiance and overall comfort experienced by respondents at Zybrick Coffee and Cantina and Threelogy Coffee are not notably different. This can be attributed to the fact that while Threelogy Coffee's lux levels meet the requirements for dining and working, some areas exceed 1000 lux, which may cause visual discomfort. A café's comfortable atmosphere arises from the combination of lighting, interior design, color, and materials. The minimalist design and white surfaces in the ceilings and walls enhance light reflection and overall brightness. According to Mulyati in [23] and Farooq et al. in [24], excessively bright lighting can result in a cold, monotonous environment if customers find high light intensity uncomfortable. Furthermore, Trisna et al. in [29] found that customers prefer cafés that maintain the essence of a café, where the lighting is not as harsh as in office settings.

In contrast, Zybrick Coffee and Cantina use dark materials and artificial lighting to create a cozy, private atmosphere. This design strategy reduces light intensity but enhances intimacy, promoting customer comfort even if the lighting doesn't meet ideal standards [22]. According to AbuThahir et al. in [7], dim lighting contributes to a warm and private setting, increasing relaxation and comfort. Cafés with this type of lighting are more appealing to customers, as the warm ambiance stimulates their psycho-visual comfort [8], [10]. In this context, dim lighting fosters an environment conducive to socializing and working, suggesting that psycho-visual comfort can offset any deficiencies in visual comfort and light intensity.

Despite the differences in lighting intensity and ambiance between Zybrick Coffee and Cantina and Threelogy Coffee, respondents found both cafés to be comfortable. This suggests that effective café lighting should incorporate both bright and dim options to accommodate various activities, as noted by Putri in [11]. Vincent et al. in [30] further support this idea, stating that customers favor cafés that utilize natural materials and colors to foster a warm atmosphere, complemented by open areas with windows. As a result, this café offers two types of lighting: warm spotlighting and cooler daylight, which enables patrons to comfortably engage in activities like relaxing, reading, and working.

A café not only sells products; the atmosphere it provides is a crucial element that consumers look for in their experience [31]. Atsnawiyah et al. in [32] and Omar et al. in [33] suggest that a pleasant café environment can enhance the likelihood of customers returning, which can positively affect the café's revenue. However, this study is limited to examining the influence of café lighting on customer comfort perception. Future research could be broadened to explore how café lighting impacts customers' health, productivity, and likelihood of returning, as these are also vital for sustaining the café business.

4. Conclusion

This study investigates lighting in cafés as multifunctional spaces that accommodate dining, socializing, working, and both formal and informal meetings. Previous research has shown that café lighting often does not meet SNI standards, yet this shortfall does not significantly affect the space's functionality for visitors. However, the impact of these lighting deficiencies on customer experiences has not been extensively explored. This study seeks to address this gap by examining how varying lighting levels influence perceptions of comfort, offering valuable insights for café owners and designers aiming to create optimal dining environments.

Threelogy Coffee and Zybrick Coffee and Cantina were selected as case studies to analyze the impact of lighting on customer perceptions and comfort. Threelogy Coffee features exceptionally high lighting intensity, exceeding the standards for dining and workspaces, particularly in the semi-outdoor areas, due to sunlight entering through large windows and skylights, and the reflective properties of white walls and ceilings. In contrast, Zybrick Coffee and Cantina has lighting intensity below the ideal standard but creates a cozy and private atmosphere with artificial lighting and dark interior materials.

Survey results indicate that customers to Threelogy Coffee are generally satisfied with the bright lighting, although there is potential for long-term monotony. Conversely, customers to Zybrick Coffee and Cantina appreciate the private ambiance, despite the dim lighting. These results emphasize that beyond just lighting, the overall ambiance of the café—comprising lighting, materials, and colors—significantly influences the quality of the customer experience.

To improve customer experience, cafés should focus on using varied lighting intensities along with thoughtful interior design. This indicates that effective café lighting should include both bright and dim options to support different activities. The café could provide two types of lighting: warm spotlighting and cooler daylight, allowing patrons to comfortably engage in activities such as relaxing, reading, and working.

Further research could explore how lighting and interior design impact various aspects of customer experience, including productivity, health, and overall satisfaction. By gaining a deeper understanding of how lighting, design, and customer comfort interact, cafés can better optimize the customer experience, enhancing both appeal and customer satisfaction.

5. Acknowledgements

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6. Conflict of Interest

The authors certify that the manuscript does not have a conflict of interest.

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Thank you for your feedback and corrections. I've updated the manuscript and highlighted the revisions in the tracking file.

Introduction

Weakness: The introduction does not clearly present the research question or hypothesis, making it unclear why the study was conducted. The context of the lighting problem in cafés is provided but not linked strongly enough to the study's aims. **Correction:** Clearly define the research question or hypothesis in the introduction. For example, specify whether the study aims to assess how varying lighting levels affect customer perceptions of comfort in different café settings. Provide a stronger rationale for why this issue is relevant, especially in the context of evolving café functions and customer expectations.

Response: I updated the introduction. The research problem arises from the evolution of cafés into multifunctional dining spaces that require varying lux levels to support different activities, highlighting the growing importance of studying appropriate lighting in these venues. While prior studies have shown that café lighting frequently does not meet SNI standards, this shortfall does not seem to impede the space's functionality for customer activities, and the effects of these lighting deficiencies on customer experiences remain largely unexplored. This study aims to address this gap by analyzing how different lighting levels affect perceptions of comfort, offering valuable insights for café owners and designers looking to create ideal dining environments. (page 2 line 39-49).

Literature review

Weakness: The literature review is insufficient and lacks a broad discussion of previous studies related to café lighting, customer comfort, and atmospheric design. **Correction:** Expand the literature review to include more recent studies and relevant theoretical frameworks. Discuss the role of lighting in café design, customer comfort, and how different lighting levels impact mood and productivity. Additionally, highlight any gaps in the literature that this study aims to address.

Response: I updated the literature review. Information about the role of lighting in café design and customer comfort is located on page 2, lines 6-21, while recent studies on café lighting can be found on lines 25-38 of the same page.

The research gap identified is that previous studies have shown café lighting frequently does not meet SNI standards. However, this shortfall does not seem to impede the café's functionality for visitor activities, and the effects of these lighting deficiencies on customer experiences have not been extensively explored (page 2, lines 44-47).

Research methodology

Weakness: The methods section is lacking in detail. It briefly mentions lux meter measurements and questionnaires but does not fully explain how the data were collected or analyzed. **Correction:** Include more detailed information on how the lux meter measurements were conducted (e.g., where and when the measurements were taken) and how the

questionnaire was designed and distributed. Clarify the sampling method, sample size, and how the results were analyzed. Ensure the methodology is comprehensive enough for replication.

Response: I updated the methodology section. Details about the field survey and measurements are outlined on page 4, lines 15-25, while the explanation for the questionnaire survey is located on page 5, lines 8-13.

Findings

Weakness: The findings are described but not adequately linked to the research questions. The terminology used to describe lighting and comfort could be more precise, and the findings are somewhat superficial. Correction: Strengthen the link between the findings and the research question. Use precise terminology, such as specifying "lux levels" or "visual comfort," when discussing lighting effects. Provide deeper analysis and interpretation of the results, explaining why certain lighting levels produce specific customer comfort outcomes.

Response: I revised the results section and added an explanation regarding lux levels and visual comfort, which can be found on page 7, lines 1-5. The further analysis can be found on page 8, lines 2-21, in the discussion section.

Discussion & analysis

Weakness: The discussion does not sufficiently interpret the findings in light of existing literature or explore the broader implications for design and customer behavior. Correction: Expand the discussion by comparing your findings with those from previous studies on lighting and customer comfort. Explore the broader implications for café design and customer experience, highlighting practical takeaways for designers and café owners. Address the limitations of the study and suggest directions for future research, such as exploring how lighting affects customer behavior in different types of cafés.

Response: I revised the discussion section. A comparison of the findings with previous studies on lighting and customer comfort is presented on page 8, lines 22-38. Suggestions for practical takeaways for designers and café owners can be found on lines 39-45, while the study's limitations and recommendations for future research are discussed on lines 46-51.

Conclusion & recommendations

Weakness: The conclusion summarizes the results but does not fully restate the research question or provide actionable recommendations based on the findings. Correction: Restate the research question and summarize how the findings addressed it. Provide practical recommendations for café designers, such as optimal lighting levels for different settings (e.g., dining, working). Additionally, suggest areas for future research, such as studying how different lighting colors or intensities influence specific customer demographics.

Response: I revised the conclusion section. The research problem is restated on page 9, lines 2-7. Practical recommendations for café designers can be found on lines 19-22, and suggestions for future research are presented on lines 23-26.

Abstract:

Weakness: The abstract provides a general overview of the topic but lacks clarity and specificity regarding the research questions, methods, and key findings. It is also vague in presenting the practical benefits of the findings.

Correction: The abstract should concisely state the main research question (e.g., how café lighting impacts customer comfort), describe the methods (e.g., lux meter measurements and questionnaires), and summarize the key findings (e.g., that bright lighting enhances comfort in certain settings while dim lighting promotes a cozy atmosphere). Additionally, mention the practical implications for café design, particularly how lighting can be optimized to enhance customer satisfaction.

Response: I updated the abstract. (page 1, lines 6-7)

Results:

Weakness: The results section presents the findings but lacks a clear structure and connection to the research questions. The findings are somewhat disorganized, and the use of tables or figures could be better integrated with the text.

Correction: Present the results in a more structured manner, clearly linking them to the research questions. Use tables or figures to display key data, such as light intensity measurements and customer responses. Ensure that each visual aid is referenced and explained within the text to provide a clearer understanding of the data.

Response: I update the results. The figures are presented to display the data.

Use of Figures and Tables: Ensure all figures and tables are properly framed and referenced in the text. Visual aids should help clarify and support the discussion.

Response: I updated the figures and checked all the figures and tables are references in the text.

References: Ensure that all cited sources are properly referenced in the bibliography, and verify that recent and relevant studies are included to strengthen the literature review.

Response: I checked all the references and citations. I used Mendeley to ensure all the citations are properly referenced in the bibliography.

Clarity and Structure: Improve the overall clarity and structure of the manuscript by ensuring that each section flows logically from one to the next, and that the research question is clearly linked to the methodology, results, and conclusions.

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The Impact of Café Lighting on Customer Comfort Perception: A Case Study of Threelogy Coffee and Zybrick Coffee and Cantina, Surabaya

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ABSTRACT

The evolution of cafés as multifunctional spaces for dining, socializing, and working has significantly influenced the standards for lighting. Previous research has shown that while café lighting frequently falls short of SNI standards, this does not impede the space's functionality, and the effects of these deficiencies on customer experiences remain largely unexplored. This study investigates the light intensity and customer comfort at Threelogy Coffee and Zybrick Coffee and Cantina, two cafés characterized by markedly different designs and lighting conditions. Field surveys and light intensity measurements using lux meter were conducted to evaluate the lighting conditions at both locations, while questionnaires were used to assess visitor perceptions of comfort. At Threelogy Coffee, light intensity levels are notably high, with indoor measurements ranging from 360 to 465 lux and reaching up to 34,705 lux in semi-outdoor areas. Conversely, Zybrick Coffee and Cantina exhibits lower light intensity, with indoor levels between 65 and 70 lux and semi-outdoor areas ranging from 240 to 670 lux. Survey results reveal that customers to Threelogy Coffee generally express satisfaction with the bright lighting, although there is a potential risk of long-term monotony. Meanwhile, customers to Zybrick Coffee and Cantina report comfort despite the dim lighting, which is attributed to the private and intimate atmosphere fostered by the café's design. Both cafés exhibit comparable levels of overall comfort, highlighting the significance of atmospheric design elements, in addition to lighting, in creating a positive customer experience. These findings indicate that cafés should adopt a range of lighting intensities along with careful interior design, utilizing both bright and dim options to cater to various activities. This could include providing warm spotlighting and cooler daylight, allowing patrons to comfortably relax, read, and work.

Keywords: atmosphere, cafés, customer comfort, lighting, visual comfort

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1. Introduction

In the modern era, the role of cafes has evolved well beyond just being a place to eat. Today, cafes often serve as multifunctional spaces for socializing, working, studying, and hosting business or social meetings. [1], [2]. Along with this shift in function, café lighting standards have also undergone significant changes [3]. Lighting, which plays a crucial role in creating an appropriate and comfortable atmosphere, can directly impact customer comfort and productivity [4], [5].

Lighting, color, room decor, and aroma are critical factors that influence the atmosphere of a café and significantly impact its appeal and customer comfort. In addition to supporting various activities, lighting also plays a crucial role in shaping the overall ambiance of the space [6], [7]. Light intensity, color temperature,

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The Impact of Café Lighting on Customer Comfort Perception: A Case Study of Threelogy Coffee and Zybrick Coffee and Cantina, Surabaya

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ABSTRACT

The evolution of cafés as multifunctional spaces for dining, socializing, and working has significantly influenced the standards for lighting. Previous research has shown that while café lighting frequently falls short of SNI standards, this does not impede the space's functionality, and the effects of these deficiencies on customer experiences remain largely unexplored. This study investigates the light intensity and customer comfort at Threelogy Coffee and Zybrick Coffee and Cantina, two cafés characterized by markedly different designs and lighting conditions. Field surveys and light intensity measurements using lux meter were conducted to evaluate the lighting conditions at both locations, while questionnaires were used to assess visitor perceptions of comfort. At Threelogy Coffee, light intensity levels are notably high, with indoor measurements ranging from 360 to 465 lux and reaching up to 34,705 lux in semi-outdoor areas. Conversely, Zybrick Coffee and Cantina exhibits lower light intensity, with indoor levels between 65 and 70 lux and semi-outdoor areas ranging from 240 to 670 lux. Survey results reveal that customers to Threelogy Coffee generally express satisfaction with the bright lighting, although there is a potential risk of long-term monotony. Meanwhile, customers to Zybrick Coffee and Cantina report comfort despite the dim lighting, which is attributed to the private and intimate atmosphere fostered by the café's design. Both cafés exhibit comparable levels of overall comfort, highlighting the significance of atmospheric design elements, in addition to lighting, in creating a positive customer experience. These findings indicate that cafés should adopt a range of lighting intensities along with careful interior design, utilizing both bright and dim options to cater to various activities. This could include providing warm spotlighting and cooler daylight, allowing patrons to comfortably relax, read, and work.

Keywords: atmosphere, cafés, lighting, visual comfort

1. Introduction

In the modern era, the role of cafes has evolved well beyond just being a place to eat. Today, cafes often serve as multifunctional spaces for socializing, working, studying, and hosting business or social meetings. [1], [2]. Along with this shift in function, café lighting standards have also undergone significant changes [3]. Lighting, which plays a crucial role in creating an appropriate and comfortable atmosphere, can directly impact customer comfort and productivity [4], [5].

Lighting, color, room decor, and aroma are critical factors that influence the atmosphere of a café and significantly impact its appeal and customer comfort. In addition to supporting various activities, lighting also plays a crucial role in shaping the overall ambiance of the space [6], [7]. Light intensity, color temperature,

and light distribution significantly influence visitor activities in coffee shops, as observed through both perception and field studies. Higher light intensity correlates with more complex activities, such as working, studying, and meetings, while lower intensity is associated with simpler social interactions. While color temperature impacts how visitors engage with the environment; warmer light colors encourage relaxation and casual conversations, whereas cooler, white light supports both socializing and more focused tasks [8]. AbuThahir et al. [7] mentioned that dimmed lighting creates an intimate atmosphere, but adequate brightness is necessary for enhancing visual comfort, as proper lighting significantly enhances customer impressions, revisit intentions, and perceptions of service quality in cafés. The integration of natural and artificial lighting creates a tranquil and inviting atmosphere, significantly influencing visual comfort. Factors that affect this comfort include lighting conditions, which can impact mood and overall well-being; the interplay of light and color, which helps establish specific atmospheres; and the presence of excessive sunlight, which can negatively affect user comfort [9]. Wardono et al. [10] recommends achieving visual comfort by establishing a harmonious ambiance and color scheme that influences people's emotions. However, the influx of daylight in a café should be noted, sometimes it can be too intense, as excessive brightness may disrupt the overall atmosphere. According to Putri et al. [11], the design of lighting in cafés must consider both visual comfort and psycho-visual comfort. Visual comfort is influenced by the intensity of light, which should be adequate for the activities being performed. Psycho-visual comfort, on the other hand, is affected by the stimuli from the surrounding lighting conditions that influence visitors' visual perceptions, emotions, and behaviors. Psycho-visual comfort refers to how the physical environment creates visual perceptions, emotions, and human behaviors. Proper lighting enhances the functionality of the space and creates a pleasant atmosphere, which can improve the customer experience and attract more customers.

In the context of cafés serving as both dining and working spaces, it is crucial to understand that these activities require different lighting levels. According to the SNI 6197:2020 standard on energy conservation in lighting systems, cafés or dining areas should have lighting levels between 100 and 250 lux. In contrast, workspaces need higher lighting levels, around 350 lux [12]. However, several studies on cafe lighting reveal that light intensity often falls short of SNI standards. Maggiet T et al. [13] noted that many restaurants overlook the functional aspect of lighting. It appears that the lighting standards in these spaces are not aligned with the needs of visitors or staff. Research at Starbucks Coffee in Cambridge City Square showed that light intensity levels do not fully comply with visual comfort standards as per SNI [14]. Similarly, Novrial et al. [8] measured light intensity at Tamoe Coffee and Resto and Makecents Coffee and Space in Medan, finding that Tamoe Coffee and Resto had a range of 100 to 155 lux, while Makecents Coffee and Space ranged from 80 to 200 lux. Putri [15] reported an average light intensity of just 58.21 lux at Caloria Cafe in Surabaya. In another study, Yahya et al. [16] measured light intensity at over 100 points in Good Dank Coffee Shop in Malang at various times and found most measurements were below 250 lux. Additionally, Ahda et al. [17] indicated that five out of six measurement points at Starbucks Jatiuwung in Banten registered below 250 lux. At Tanatap Ring Garden Coffee Shop in Ampera Jakarta, light intensity measurements across three areas showed that only two areas met SNI standards, while the third area fell below 250 lux. This was due to the latter area being designed for a relaxing atmosphere, while the other two were intended for work activities.

Given that 80% of information is processed visually, lighting is essential in shaping a space's atmosphere [18]. As cafés evolve into multifunctional dining environments which require different lux level to accomodate various activities, research on appropriate lighting in cafés becomes increasingly important [19]. Adequate lighting not only enhances safety but also contributes to customer comfort and satisfaction [20]. While existing studies often explore the link between lighting design and customer behavior in cafés [6], [7], few focus specifically on how varying lighting conditions impact customers' perceptions and comfort. Although previous research has indicated that café lighting often falls below SNI standards, this discrepancy does not hinder the space's functionality as a place for visitors' activities at the coffee shop and the implications of these deficiencies on customer experiences have not been thoroughly investigated [8]. This study aims to fill this gap by examining how different lighting levels influence perceptions of comfort, providing valuable insights for café owners and designers seeking to create optimal dining environments.

2. Method

2.1 Case studies

This study seeks to assess how different lighting levels affect customer comfort at two cafés with distinctly different design characteristics and lighting conditions: Threelogy Coffee and Zybrick Coffee and Cantina. Threelogy Coffee and Zybrick Coffee and Cantina were selected as case studies because both serve similar functions as dining spots and gathering places for young people (Figure 1). Threelogy Coffee, located on Mojopahit street, is near educational institutions such as Widya Mandala Catholic University and Santa Maria High School. Zybrick Coffee and Cantina is situated on Siwalankerto street, close to Petra Christian University. Choosing these two cafés allows for a comprehensive evaluation of how lighting impacts customer comfort in environments that both cater to academic and young professional communities.



Figure 1 (a) Building facades of Threelogy Coffee and (b) Zybrick Coffee and Cantina.

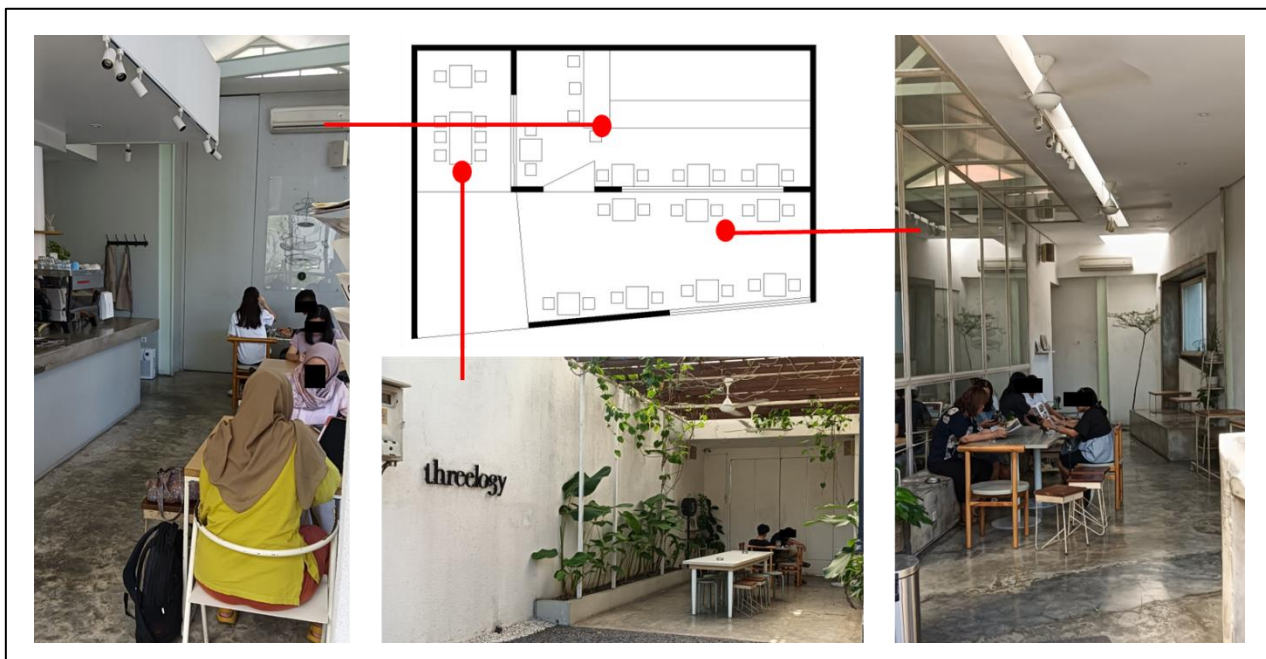


Figure 2 Atmosphere of Threelogy Coffee.

Although both cafés serve similar functions and target audiences as dining, social, and workspaces, their interior designs are markedly different in terms of natural lighting, color schemes, and materials. These design differences create a contrasting atmosphere between the two cafés [21]. Threelogy Coffee utilizes natural lighting through windows and skylights and features exposed concrete with bright colors such as white and gray (Figure 2). Threelogy Coffee exemplifies a modern café design that heavily relies on natural lighting. Its façade features numerous large windows that allow maximum sunlight to enter, while skylights further enhance the natural light, creating a bright and airy atmosphere throughout the day. The use of white walls and ceilings,

along with exposed concrete, reflects light and improves overall illumination within the space. This design creates an impression of spaciousness, minimalism, and cleanliness while also imparting a sense of freshness. Beyond its visually appealing effect, it enhances customer comfort through its bright lighting.



Figure 3 Atmosphere of the ground floor of Zybrick Coffee and Cantina.

Conversely, Zybrick Coffee and Cantina operates on a different principle. Relying primarily on artificial lighting, this café creates a more intimate and private atmosphere. Interior materials such as exposed brick and dark wood with a dark-colored ceiling are selected to impart a warm and luxurious feel, though this also limits natural light entry (Figure 3). Artificial lighting, strategically designed, aims to create a cozy ambiance that supports socializing and working. Although the lighting intensity might not meet the optimal standards for workspaces, the interior design offers a unique and attractive visual quality. This design creates a more private, luxurious, elegant, comfortable, and warm atmosphere [22], [23].

2.1 Field measurement and questionnaire survey

This study employs field survey and questionnaire to evaluate lighting and comfort at Threelogy Coffee and Zybrick Coffee and Cantina. The field survey involves measuring light intensity and documenting the lighting conditions in both cafés. To capture accurate data on natural illumination, measurements at Threelogy Coffee were conducted at noon when sunlight is most intense, specifically on August 31, between 11:00 AM and 2:00 PM. Similarly, the survey at Zybrick Coffee and Cantina was carried out on August 3, during the same time frame.

A lux meter was employed to measure light intensity at key locations throughout the cafés, including dining tables, semi-outdoor areas, and near windows (Figure 4). The lux meter was placed directly on the tables. Although Zybrick Coffee and Cantina has two floors available for dining, this study focused solely on the ground floor due to the second floor being closed at the time of the survey and questionnaire administration. The collected light intensity data, measured in lux, were analyzed to determine whether the lighting meets the standards for dining and workspaces as defined by SNI.

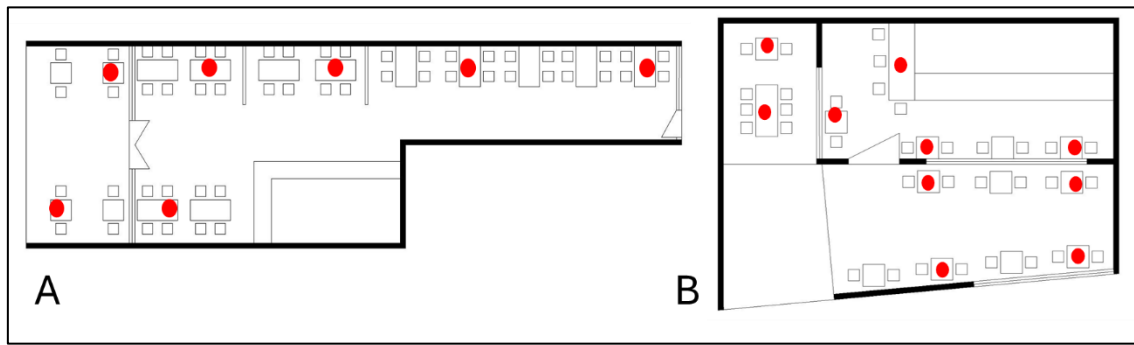


Figure 4 Measurement points at Zybrick Coffee and Cantina (a) and Threelogy Coffee (b).

In addition to the field survey, questionnaires are distributed to customers present at the cafés during the field survey. The questionnaires are designed to gather data on customers' perceptions of lighting and café comfort. They include questions about lighting levels, visual comfort, atmospheric comfort, and overall satisfaction. Respondents rate their experience on a scale of 1 to 4, where 1 indicates dissatisfaction and 4 indicates maximum satisfaction (Figure 5).

On August 31, during the survey at Threelogy Coffee, questionnaires were given to 20 customers between 11:00 AM and 2:00 PM. At Zybrick Coffee and Cantina, on August 3, 18 customers were surveyed during the same time frame. The collected questionnaire data will be analyzed to identify patterns and trends in customer perceptions of lighting and ambiance at each café. The findings from both the light intensity measurements and the questionnaire responses will be compared and analyzed to evaluate visitor perceptions of lighting and comfort in each location.

Café Condition Assessment Questionnaire Based on Customer Perception

Instructions: Please rate the following aspects of the café based on your experience, using a scale of 1 to 4. Your responses will help us understand and improve the café environment.

1. On a scale of 1 to 4, how would you rate the lighting level at this café?
 - 1 – Poor: The lighting is inadequate and uncomfortable.
 - 2 – Fair: The lighting is somewhat adequate but could be improved.
 - 3 – Good: The lighting is sufficient and generally comfortable.
 - 4 – Excellent: The lighting is optimal and enhances the overall experience.
2. On a scale of 1 to 4, how would you rate the visual comfort at this café?
 - 1 – Poor: The visual comfort is uncomfortable or bothersome.
 - 2 – Fair: The visual comfort is somewhat adequate but could be improved.
 - 3 – Good: The visual comfort is generally pleasant and suitable.
 - 4 – Excellent: The visual comfort is optimal and enhances the overall experience.
3. On a scale of 1 to 4, how would you rate the comfort of the ambiance at this café?
 - 1 – Poor: The ambiance is uncomfortable or uninviting.
 - 2 – Fair: The ambiance is somewhat pleasant but could be improved.
 - 3 – Good: The ambiance is generally comfortable and enjoyable.
 - 4 – Excellent: The ambiance is highly comfortable and creates a very pleasant experience.
4. On a scale of 1 to 4, how would you rate the overall comfort at this café?
 - 1 – Poor: The overall comfort is unsatisfactory.
 - 2 – Fair: The overall comfort is acceptable but could be improved.
 - 3 – Good: The overall comfort is generally satisfactory and pleasant.
 - 4 – Excellent: The overall comfort is outstanding and enhances the entire experience.

Figure 5 Questionnaire for evaluating café conditions based on customer perceptions.

3. Results and Discussion

3.1 Light intensity measurements

Light intensity measurements were taken at several key locations in both cafés. At Threelogy Coffee, measurements were conducted in the indoor area, near the windows, and in the semi-outdoor space. In contrast, measurements at Zybrick Coffee and Cantina were taken in the indoor area, the semi-outdoor space, and near artificial lighting sources.

At Threelogy Coffee, light intensity measurements reveal significant variations between indoor and semi-outdoor areas. The indoor area has lux level ranging from 360 to 465 lux, while near the windows, the level reaches up to 3,460 lux. In the semi-outdoor areas, lux level varies from 723 to 1,535 lux, and in some parts of the semi-outdoor space, it can peak between 4,245 and 34,705 lux (Figure 6). These results indicate that Threelogy Coffee features very high lux levels, particularly in the semi-outdoor areas, which far exceed the standard lux levels for dining and workspaces. In contrast, Zybrick Coffee and Cantina exhibits lower light intensity compared to Threelogy Coffee. Measurements in the indoor area show lux level ranging from 65 to 70 lux, while in the semi-outdoor areas, it ranges from 240 to 670 lux (Figure 7). This lux level falls within the standard range for dining and workspaces. The lower lux level at Zybrick Coffee and Cantina is attributed to the minimal natural light entering the indoor area and the use of dark-colored materials, which reduce light reflectance.

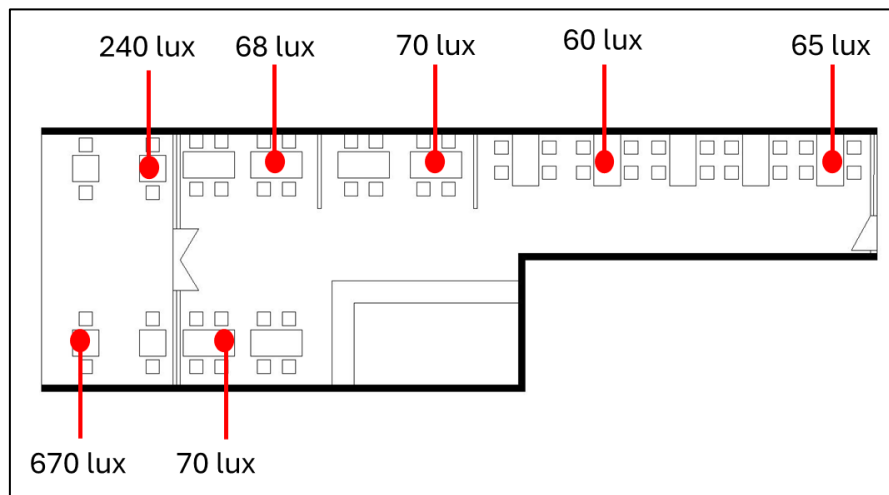


Figure 6 The light intensity measurements at Zybrick Coffee and Cantina.

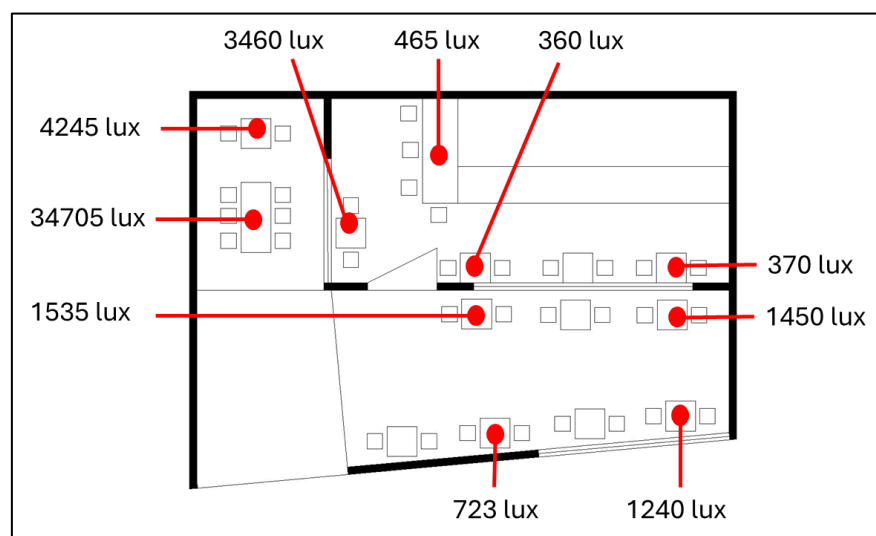


Figure 7 The light intensity measurements at Threelogy Coffee.

According to SNI standards, Threelogy Coffee has attained the required lux level for visual comfort, meeting the necessary criteria for both dining and working. However, the lux levels in the semi-outdoor area often exceed 1000 lux, which could lead to visual discomfort. In contrast, Zybrick Coffee and Cantina did not meet the visual comfort standards, as their lux levels fall significantly below the minimum required for these activities.

3.2 Questionnaire survey results

Questionnaire survey results (Figure 8) show that customers to Threelogy Coffee generally perceive the café as bright and visually appealing. About 75% of respondents rated the visual comfort as either 3 or 4 (good or excellent), while 70% rated the ambiance comfort as 3 (good). Overall, 80% of customers felt comfortable, scoring 3 or 4. These findings are consistent with the light intensity measurements, which reveal that Threelogy Coffee has exceptionally bright lighting.

In contrast, customers to Zybrick Coffee and Cantina often describe the café as relatively dim. Approximately 77.78% rated the lighting as 1 or 2 (poor or fair). Despite this, many still reported feeling comfortable, with 55.56% rating visual comfort as 3 or 4 (good or excellent), and 77.78% rating ambiance comfort as 3 or 4. These results suggest that, although Zybrick Coffee and Cantina has lower lighting levels, its ambiance still provides a high level of comfort for its guests and in general, 77.78% of the respondents felt comfortable.

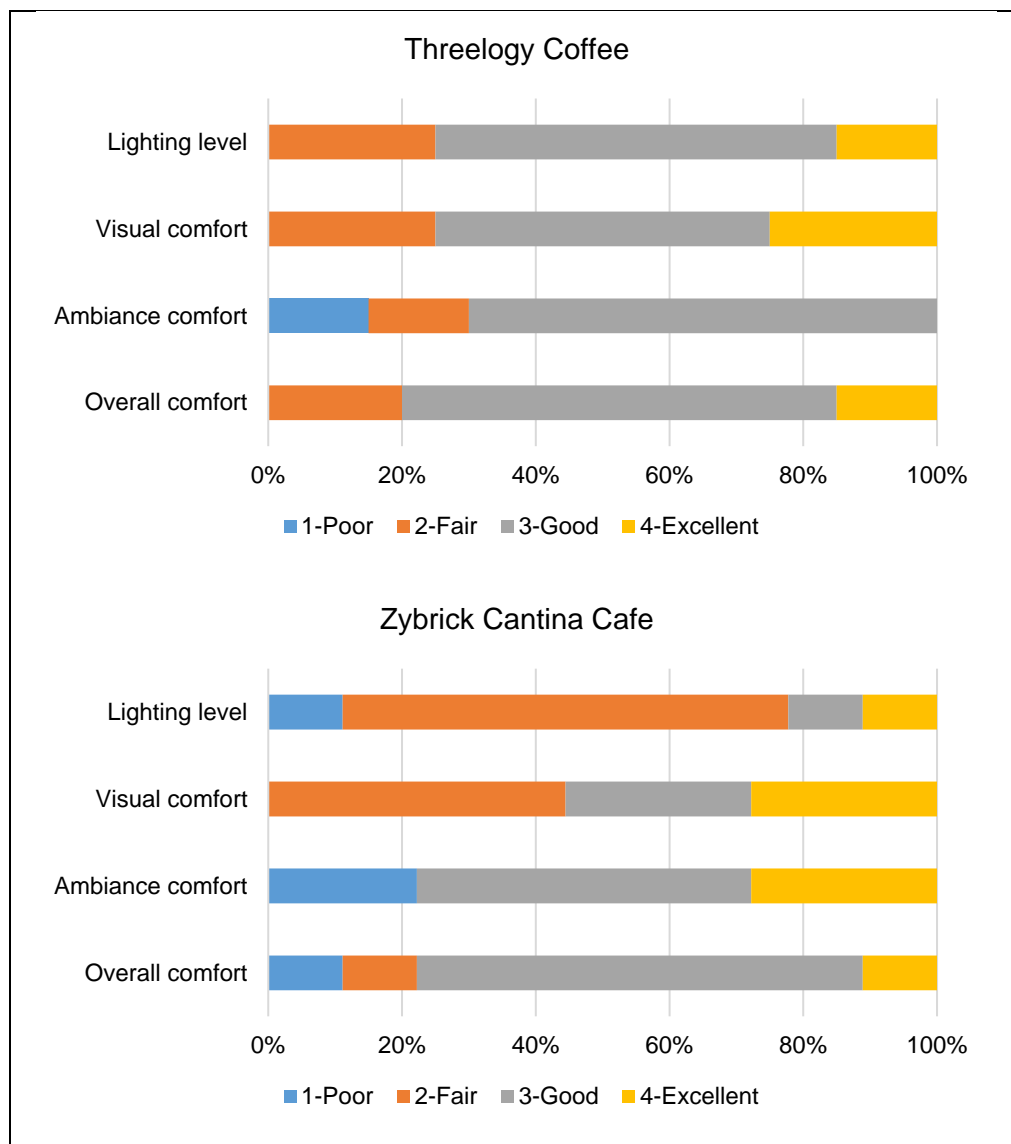


Figure 8 Questionnaire survey results for Threelogy Coffee and Zybrick Coffee and Cantina.

3.3 Discussions

The lighting at Threelogy Coffee is notably bright, especially in the semi-outdoor areas, with light intensity surpassing the standard levels for dining and workspaces. This high level of illumination is attributed to sunlight streaming through large windows and skylights, as well as reflections from white materials on the ceiling and walls. The bright lighting effectively draws customers' attention to the menu and food, enhancing visual comfort during meals [17]. However, excessively bright lighting can create a cold and monotonous atmosphere if customers spend extended periods in the café [23]. Research by Farooq et al. in [24] suggests that while very bright lighting provides good short-term visual comfort, it can lead to a sense of monotony and boredom over time. Questionnaire survey results indicate that customers at Threelogy Coffee are generally satisfied with the bright and visually comfortable lighting. However, the very bright lighting could impact long-term customer comfort, suggesting that lighting design should also consider the overall ambiance.

In contrast, the low lighting at Zybrick Coffee and Cantina is due to limited natural light and the use of dark-colored materials that reduce light reflectance. Although the light intensity falls below the ideal standards for dining and workspaces, the interior design—featuring exposed brick and dark wood—creates a warm and cozy atmosphere [21]. The artificial lighting used in the interior design contributes to a private and relaxing ambiance, particularly for customers who come to work or socialize. This aligns with findings that dim lighting can foster a relaxing and comfortable environment [25], [26]. Although customers at Zybrick Coffee and Cantina perceive the café as dim, they still find it comfortable due to its intimate atmosphere and interior design that fosters a sense of privacy. This suggests that a well-designed ambiance can compensate for deficiencies in light intensity, as previous research highlights that a well-crafted ambiance can enhance customer comfort even when lighting does not meet ideal standards [27], [28].

The research highlights a gap indicating that café lighting often falls short of SNI standards, yet this does not significantly impact the café's function. The findings suggest that the ambiance and overall comfort experienced by respondents at Zybrick Coffee and Cantina and Threelogy Coffee are not notably different. This can be attributed to the fact that while Threelogy Coffee's lux levels meet the requirements for dining and working, some areas exceed 1000 lux, which may cause visual discomfort. A café's comfortable atmosphere arises from the combination of lighting, interior design, color, and materials. The minimalist design and white surfaces in the ceilings and walls enhance light reflection and overall brightness. According to Mulyati in [23] and Farooq et al. in [24], excessively bright lighting can result in a cold, monotonous environment if customers find high light intensity uncomfortable. Furthermore, Trisna et al. in [29] found that customers prefer cafés that maintain the essence of a café, where the lighting is not as harsh as in office settings.

In contrast, Zybrick Coffee and Cantina use dark materials and artificial lighting to create a cozy, private atmosphere. This design strategy reduces light intensity but enhances intimacy, promoting customer comfort even if the lighting doesn't meet ideal standards [22]. According to AbuThahir et al. in [7], dim lighting contributes to a warm and private setting, increasing relaxation and comfort. Cafés with this type of lighting are more appealing to customers, as the warm ambiance stimulates their psycho-visual comfort [8], [10]. In this context, dim lighting fosters an environment conducive to socializing and working, suggesting that psycho-visual comfort can offset any deficiencies in visual comfort and light intensity.

Despite the differences in lighting intensity and ambiance between Zybrick Coffee and Cantina and Threelogy Coffee, respondents found both cafés to be comfortable. This suggests that effective café lighting should incorporate both bright and dim options to accommodate various activities, as noted by Putri in [11]. Vincent et al. in [30] further support this idea, stating that customers favor cafés that utilize natural materials and colors to foster a warm atmosphere, complemented by open areas with windows. As a result, this café offers two types of lighting: warm spotlighting and cooler daylight, which enables patrons to comfortably engage in activities like relaxing, reading, and working.

A café not only sells products; the atmosphere it provides is a crucial element that consumers look for in their experience [31]. Atsnawiyah et al. in [32] and Omar et al. in [33] suggest that a pleasant café environment can enhance the likelihood of customers returning, which can positively affect the café's revenue. However, this study is limited to examining the influence of café lighting on customer comfort perception. Future research could be broadened to explore how café lighting impacts customers' health, productivity, and likelihood of returning, as these are also vital for sustaining the café business.

4. Conclusion

This study investigates lighting in cafés as multifunctional spaces that accommodate dining, socializing, working, and both formal and informal meetings. Previous research has shown that café lighting often does not meet SNI standards, yet this shortfall does not significantly affect the space's functionality for visitors. However, the impact of these lighting deficiencies on customer experiences has not been extensively explored. This study seeks to address this gap by examining how varying lighting levels influence perceptions of comfort, offering valuable insights for café owners and designers aiming to create optimal dining environments.

Threelogy Coffee and Zybrick Coffee and Cantina were selected as case studies to analyze the impact of lighting on customer perceptions and comfort. Threelogy Coffee features exceptionally high lighting intensity, exceeding the standards for dining and workspaces, particularly in the semi-outdoor areas, due to sunlight entering through large windows and skylights, and the reflective properties of white walls and ceilings. In contrast, Zybrick Coffee and Cantina has lighting intensity below the ideal standard but creates a cozy and private atmosphere with artificial lighting and dark interior materials.

Survey results indicate that customers to Threelogy Coffee are generally satisfied with the bright lighting, although there is potential for long-term monotony. Conversely, customers to Zybrick Coffee and Cantina appreciate the private ambiance, despite the dim lighting. These results emphasize that beyond just lighting, the overall ambiance of the café—comprising lighting, materials, and colors—significantly influences the quality of the customer experience.

To improve customer experience, cafés should focus on using varied lighting intensities along with thoughtful interior design. This indicates that effective café lighting should include both bright and dim options to support different activities. The café could provide two types of lighting: warm spotlighting and cooler daylight, allowing patrons to comfortably engage in activities such as relaxing, reading, and working.

Further research could explore how lighting and interior design impact various aspects of customer experience, including productivity, health, and overall satisfaction. By gaining a deeper understanding of how lighting, design, and customer comfort interact, cafés can better optimize the customer experience, enhancing both appeal and customer satisfaction.

5. Acknowledgements

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6. Conflict of Interest

The authors certify that the manuscript does not have a conflict of interest.

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The Impact of Café Lighting on Customer Comfort Perception: A Case Study of Threelogy Coffee and Zybrick Coffee and Cantina, Surabaya

October 30, 2024

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Subject: Consent for Article Publication

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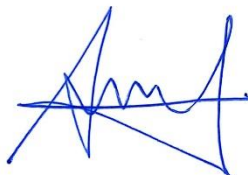
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