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Preference technique: deceptive visual representations in the digital realm

Niccolas Troy Putra Heriyanto, Arina Hayati*, Didit Novianto
Department of Architecture, Faculty of Civil Planning and Geo-Engineering, Institut Teknologi Sepuluh Nopember, Indonesia

Abstract
In the digital era, architectural designs can be quickly visualized. However, the material abstraction from digital visualization tools may reduce immersion and make it hard to recognize design intention. This paper discusses how architectural students acknowledge the design representation despite various ways of visualization. Material is key to visualizing architecture by adding realism, depth, and texture. People create mental concepts of material beyond words. Thus, design representations can have positive or negative impacts depending on how effectively the idea is delivered to the audience. This study uses a quantitative method to investigate the extent to which the preference technique of students represents the design's idea. The study's main objective is to identify the criteria for representation that effectively convey the designer's intentions while minimizing visual deception. The analyzed data is classified into three archetypes consisting of (1) the student's previous knowledge about representation, (2) the intention of design representation, and (3) mass and material in representation. The result shows no strict correlation between previous knowledge and the preferred idea representation technique. Yet, the result indicates a correlation between previous knowledge and techniques used to represent material. The photorealism technique is preferable in representing the clarity of material in representation. Photorealism has advantages in showing the quality of shade in the material. On the other hand, respondents tend to choose to use sketches to show information about scale and mass. The research comprehensively explains this phenomenon in the context of positive theory, particularly in design communication and representation.

Keywords:
Architecture;
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Corresponding Author:
Arina Hayati
Department of Architecture, Faculty of Civil Planning and Geo-Engineering, Institut Teknologi Sepuluh Nopember, Indonesia,
Email: arina_h@arch.its.ac.id

INTRODUCTION

There are limitations of non-digital visualization tools that can affect perception and lead to deceptive side effects [1]. The visualization tools may result in having different interpretations perceived by users. This research aims to bring visual perception and materiality into digital visualization by adopting non-digital visualization tools. With the advancements in technology, many styles of representation have emerged [2].

However, these new styles sometimes prioritize creativity over clarity, which can be misleading. It is important to understand the designer's intention and preference for visualization methods to ensure that visualizations are not biased. The ideal representation should not be prejudiced and can be identified by simulating the abstraction of material in visualization and confirming it with the designer [3]. The study's invention helps students expand their knowledge of visualization tools.

Therefore, understanding the designer's intent and preference for visualization methods can help extend the range of digital representation tools, ensuring that the visualization is not biased. Although technology has greatly aided the design

process, it also affects how architects approach design thinking, and sometimes comes at the cost of losing certain sensory experiences [4].

With digital representation revolutionizing the design process, it bridges the architect's imagination with the physical realm, making ideas tangible and facilitating feedback for future design [5] The process of translating an idea into a product is part of the design process, which consists of the production process and the creativity process.

Nowadays, technology greatly aids the design process with software for modeling and evaluating buildings. However, this also impacts how architects approach design thinking with software. Previously used for representation, the software now generates entire concepts and not only shows how a building looks in real life but also represents the process of constructing it. While software helps streamline the design process, it does come at the cost of losing certain sensory experiences, such as haptic feedback. As architecture is fabricated digitally, the engagement with materials is diminished [2][4].

Digital representation revolutionizes the design process by bridging the architect's imagination with the physical realm, making ideas tangible, and facilitating feedback for future design [3]. There are two main aspects of representation: translating design ideas into a medium and interpreting the representation to understand design concepts. These two processes constantly interact, conveying and comprehending design ideas through representation.

Perception is the process of interpreting what is observed, specifically representation. It is derived from reactions to physical objects that have been observed and accumulated into mental images and experiences [6]. Some individuals who predominantly use the left hemisphere of the brain may not easily create visual images in their imagination. However, they are still able to distinguish one object from others. This recognition of distinguished objects necessitates a detailed comparison of visual images stored in the mind. Visual images can reshape the mind and stimulate creative thought. Visualization plays a crucial role in design thinking, as it helps in generating ideas and understanding design data. It is an integral part of the theoretical design thinking process, which combines design tools, methods, and perspectives from outside of architectural syntax to solve user-acknowledged problems [7]. Architectural images also can evoke responses and provide insight into the built environment, thus later influencing people's perception of space [8].

When communicating design, especially through images, a deceptive side can emerge [9]. Visualization can change how a client perceives a concept, making it appear more realistic than an actual landscape. The scale and dimensions may appear different from the final project. The lack of effectiveness in communicating visualizations can cause bias in the representation [5]. The paper highlights how visualization is misused as a business strategy rather than an honest representation and how it relies on direct experience for comparison with perception. Although there are two impacts because of perceived information, this research emphasizes the negative impact of biased representation. Design should be communicated through visualization, allowing users to perceive as intended. Based on previous research, the essence of visual communication includes the visual elements, such as images, color, layouts, and illustration [10]. Ultimately, visualization should be viewed as an extension of the designer's ability to communicate ideas to clients. While it may not be able to portray reality exactly, it still must convey a clear and truthful concept to the user. Any ambiguity or deception is unacceptable [5].

The research aims to identify the factors that affect the recognition of specific materials and the extent of their visualization. The purpose is to help people understand how they can identify different types of materials using various visualization techniques. Through an intersubjective paradigm, the study acts as a bridge to the gap in previous research and addresses the following statement: "How architecture student's knowledge can alter the preference for representing architecture ideas, in the context of materiality".

METHOD

The research focuses on the representation of architecture during the conceptual design phase, using tools such as orthographic and perspective drawing. Each tool has a specific purpose, with orthographic projection providing accurate information in the form of elevation. Perspective drawing creates a two-dimensional drawing of a three-dimensional object from a subjective viewpoint, mimicking human vision.

Material

To answer the research questions, the preferable approach is using sorting images. Two major variables can be utilized, representation and visual perception. The question is answered by creating images that represent both variables. The image is sorted into two sections, the first section

is used for collecting information, and the second section acts as a further explanation of answering the research question. Both sections are shown respectively in Figure 1 and Figure 2. The image that is used is controlled by several variables, such as the position, using the shape, object, and background to avoid a biased perception.

Each of the image sections (Figure 3 and Figure 4) consists of seven drawing styles, which are pencil sketches, watercolor, ink sketches, oil painting, vector/illustration, collage, and photorealism. The first section uses a simple cube form and one type of material to control the other intervention of material (Figure 1). Simple objects have recognizable boundaries, such as lines or curves, which create an easier time for the viewer to analyze and interpret [11]. The second section uses a more complex form, consisting of the arrangement of several three-dimensional blocks with several types of material (Figure 2). The purpose of the second section is to know the intervention of other materials in shaping perception and the awareness of the designer in representing ideas. The second section of the image focused more on the complex information of the first section.

In creating the image from the first section, the geometrical cube is shaped using Rhinoceros software and rendered using the in-built rendering software (a). The texture of the material that is used in creating images comes from the free online platform (b). The light that is used is manipulated, simulating real sunlight. The image is exported into PNG format with 300 dpi quality (c). The same process is repeated to create the second section of the image, although the cube is changed into a complex arrangement of cubes with several types of material, such as bricks, masonry, steel, and timber.

After that, the basic geometrical form is edited in Adobe Photoshop to create an imitated effect on several drawing styles in digital representation (d). All the drawing styles are mainly utilizing the feature of filter gallery in Adobe Photoshop. For example, a sketch style uses a graphic pen filter with 4 points of stroke length, 6 points of light/dark balance, and a right diagonal stroke direction (Figure 3 and Figure 4).

All the sketch filters use this same treatment. Vector/illustration type utilizes the cutout filter in Adobe. Collage drawing uses seamless texture and collages it into the intended shape. Photorealism drawing uses the same original render that already previously applied. The materials are used in image sorting as an approach to understanding the perception of students in representing the idea [12, 13, 14, 15, 16, 17].

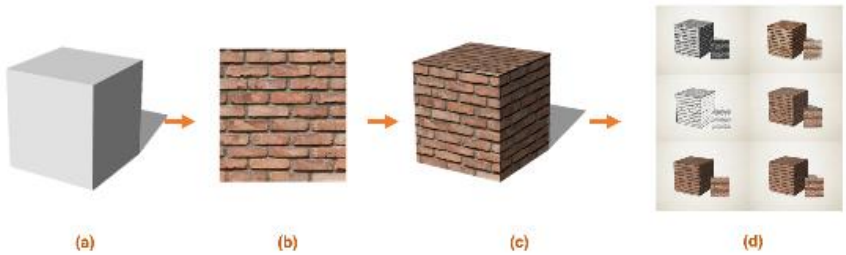

Figure 1. Cube with Brick Textured Material: (a) Cube (b) Material Texture (c) Base Unedited Image (d) Edited Image)

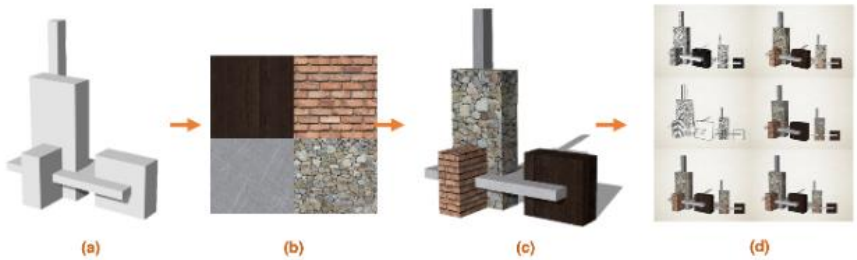

Figure 2. Complex Arrangement of Blocks with Several Types of Material: (a) Cubes (b) Material Texture (c) Base Unedited Image (d) Edited Image

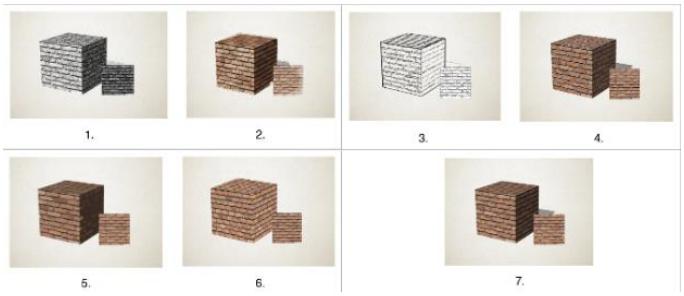

Figure 3. First Section of Image Sorting: (1) Sketch (2) Watercolor (3) Oil Paint (4) Ink Sketch (5) Illustration/Vector (6) Collage Drawing (7) Photorealism)

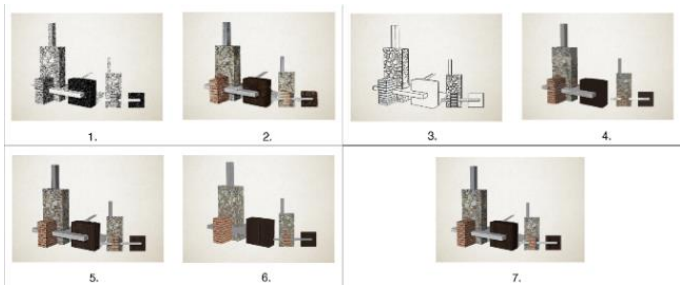

Figure 4. Second Section of Image Sorting: (1) Sketch (2) Watercolor (3) Oil Paint (4) Ink Sketch (5) Illustration/Vector (6) Collage Drawing (7) Photorealism)

Methods

In this research, the context of architectural representation is focused on materiality. As material is mainly used as a construction factor in architecture, the characteristic of space is defined using the material's composition [18].

By contrasting each type of architectural representation style and techniques, visual attributes that create bias are determined. The spectrum of favorable architectural representation that suits the intention of the designer and is grasped fully by the client is generated from the analyzed visual attribute earlier.

For this research, orthographic drawings, including elevation and perspective drawings are used as tools. Elevation is advantageous in delivering facade information, such as mass, texture, shape, and material, while perspective drawing provides a comprehensive understanding of the building and its surrounding context [19].

To ensure consistency among the respondents, only architecture students are selected. The level of student knowledge becomes a variable affecting visual perception, and the intention of the students is limited to communicating their conceptual ideas. The purpose of selecting students as respondents is to consider their explorative nature in conveying their ideas. Architects tend to be stuck in their chosen paradigm, style, and ideology. This behavior creates a bias in research, thus first to fourth-year architecture and post-graduate students are included in the study.

Respondents are selected from institutes in Surabaya that have architecture majors. The knowledge of architecture students plays a crucial role in data collection. To control the diversity of knowledge, only schools with an A accreditation were selected, in this test case, Institut Teknologi Sepuluh Nopember is selected. The university selection also considers the accessibility and acceptability of the respondents.

Respondents consisted of first to fourth-year and post-graduate architecture students. Each year is expected to have increased knowledge about architecture visualization, making them eligible for the study. According to studies, design studios play a fundamental role in enhancing student creativity in architectural education [20][21]. Design studios enable students to experiment with different design solutions to design problems, providing flexibility in exploring the problem and creating a design approach based on their engagement. The design studio is vital because it sets up a course for students to gain knowledge about practical and theoretical design and creativity.

The variable is used to define the element of shaping the image for data collection (image sorting) (Table 1). Physical attributes in architectural representation consist of mass, structure, surface, and materials.

Table 1. Variables in Research

Parameter	Variable	Sub Variable
Representation	Attribute	Mass
		Light
		Surface
		Material
		Scale
	Drawing	Sketching
	Styles	Watercolour
		Oil Painting
		Digital/Photorealism
		Painting
		College
		Illustration/Vector
		Photorealism
	Tools	Elevation drawing
		Perspective drawing
Visual Perception	Material	Mass
		Massiveness
		Heaviness/Lightness
		Hardness/Softness
		Transparency
		Light/shade
		Three Dimensionality

A sense of mass is created by the composition of the conceived solid form. Volume of solid form can be achieved from addition or subtractive. Material is the designer's instrument for creating textural manipulation. Scale is relative as it is only defined by the relation of something and heavily depends on context. Scales can be measured by physical or perceptual engagement. Physical engagement is related to the dimensions of the human body, while perceptual is related to the visual perception of the observer. Light creates the possibility of illumination that later enriches the spatial experience [22]. Three-dimensionality is related to the depth perception that emerges from perceiving a two-dimensional image as if the image is in three dimensions [23].

Architectural technique in architectural representation related to media for producing the image. However, in this research, the architectural technique is more on the unique quality of the image, not on the technique itself. Architectural techniques consist of sketching (both pencil and ink), painting (both watercolor and oil painting), vector or illustration, and photorealism (digital render). The attributes of the material consisted of mass and massiveness, the weight of the material, the quality of the surface, the information of illumination, and volumetric information [18].

To ensure the respondent knows how knowledge about representation helps represent the idea, the respondent is asked before filling in the first and second sections. After that, the bias from drawing needs to be reduced first by asking the respondents if they can distinguish the different types of visualization. All sections of the image are then included in the Questionnaire form utilizing Microsoft Forms as a platform to distribute questionnaires. The design of the questionnaire consisted of three sections, the first part of the questionnaire asks to identify the knowledge of the respondent, and the second and third part is used to rank the sorted image, to each of the questions that are based on variables already been discussed. Data is collected in the cloud and can be processed and displayed anytime. The question is quantified by the Likert scale and ranking system. The scale ranges from Very Disagree (1), Disagree (2), Agree (3), and Very Agree (4).

RESULTS AND DISCUSSION

There are at least thirty-three respondents who participated in answering the questionnaire, with the distribution of 8 males and 25 females. Respondents were distributed among 9 students from the second year, 8 students from the third year, 4 students from the fourth year, 4 students from the first year, and 8 students from the postgraduate (Figure 5). This distribution means that there is a representative for each year's grade.

There are three questions to check the knowledge about representation. The first question is to check if the respondent has already gained knowledge about architectural representation. Data shows that 87.9% of respondents have achieved the knowledge, while 12,1% already know, but not enough (Figure 6). The second question asks how knowledge about representation helps respondents in creating an architectural representation.

From the gathered data can be concluded that all respondents already gained knowledge about architectural representation, so the answer for the next section is not biased.

Respondents also include which software they usually use in producing architectural representation, consisting of Adobe Illustrator, Adobe Photoshop, Figma, Canva, PowerPoint, and other software mainly for modeling and rendering such as Sketchup, Rhinoceros, Lumion, and Enscape.

The third question in this section is to check the bias from the image itself. From the data itself can be concluded that while many respondents can distinguish the differences among styles, still there are 33.3% of respondents that cannot easily see the differences (Figure 7). This problem will be addressed later in the next discussion.

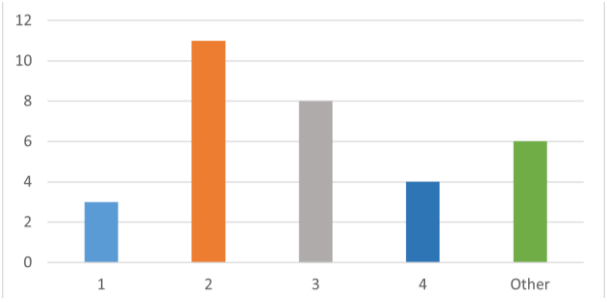

Figure 5. The Distribution of the Academic Year among Respondents

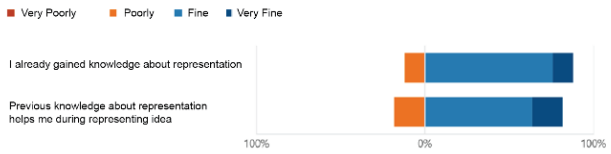

Figure 6. The Distribution of Previous Knowledge

Figure 7. The Distribution of Distinctive Style

However, based on several responses, the problem arising from the images from the first section is incomparable, since they only show one material embodied in a simple cube, instead of the second section which consists of different types of material in a complex arrangement.

The result is processed using SPSS by table analysis, cross the academic year and previous knowledge as shown in Figure 8. It does not show a strong correlation between both variables since the respondent distribution is not the same. However, it still can be concluded that most respondents in academics had good previous knowledge about representation.

Previous research suggests the ability to understand and interpret the visual information is based on their visual literacy [24]. The expanded visual literacy allows the individual to comprehend visual information effectively and accurately. They also can recognize visual information accurately with fewer visual cues since they already developed their cognitive schema [25]. Intensive exposure to architectural representation can enhance the student's cognitive development, which influences their knowledge in recognizing visual information [26].

Based on the result, the sketch is preferable in showing the quality of creativity to the client, followed by ink sketch, vector/illustration, and watercolor. Both sketches are more favorable than others and can be the result of the personal creativity that the designer put into the drawing.

		Level of Knowledge	
		Poor	Fine
		Count	Count
Year	Other	2	7
	1	2	3
	2	1	11
	3	2	8
	4	1	4

Figure 8. Cross-tab Analysis between Academic Year and Previous Knowledge

On the other hand, to get to know the intention of the designer, respondents preferred to choose vector/illustration to represent the idea, followed by photorealism. This phenomenon shows that vector/illustration is a way to present abstract ideas to students with poor knowledge of representation to make sure they understand common knowledge. By reducing a set amount of detail, people tend to grasp the idea faster than the complicated detailed image. This reason is strengthened by the fact that the least favorable style is college drawing and oil painting. College drawing is constructed by juxtaposing several images into one big image, while oil paint has some amount of detail and has a unique texture.

Figure 9 shows the distribution of academic year in choosing preference technique, although most of the respondent seems to show choosing sketches as the most preferable. It also shows that most respondents choose sketches as a favorable technique, although they have not had good previous knowledge about representation. Sketches can easily spark creative intention and create a deeper understanding of architecture as both constructed and construed [27][28]. Photorealism is not the most preferable technique to choose. This finding correlates with a previous study [29], which shows concern that overemphasizing photorealism may overshadow the intended architectural message.

Mass is constructed by the shape of mass itself, the scale of mass, and the three-dimensionality of mass. Based on the data gathered from respondents, each of the variables constructing the mass is represented by different favorable styles. Illustration is shown to be the most preferable style to deliver clarity of mass. Then followed by photorealism and both sketches, while both painting style and college technique are left behind. This phenomenon shows that the outline of mass holds a significant factor in forming the shape. In both painting and collage drawings, the shape is rather blurry since they did not strictly form the image using the direct line, rather than the uniqueness of technique.

Respondents tend to use photorealism to show the spatial quality in architectural representation, while to show the scale of mass, the sketch is the most favorable. The information about light and shade holds significant factors in enriching spatial experience, which is provided by using photorealism style. On the other hand, to show the information about the scale of mass in representation, respondents tend to choose to use sketches.

The results from Figure 10 show the distribution between year and level of knowledge to represent mass (mass itself, three-dimensionality of mass, and scale of mass). Analyzed data shows that most respondents tend to choose sketches, illustrations, and photorealism and leave painting as not a favorable technique.

		Creativity and Intention			
		Sketch	Panting	Illustration	Photorealism
		Count	Count	Count	Count
Level of Knowledge	Poor	6	0	3	3
	Fine	23	4	13	13

Figure 9. Cross-tab analysis between Previous Knowledge and Chosen Technique to Represent the Idea

		Mass			
		Sketch	Panting	Illustration	Photorealism
		Count	Count	Count	Count
Level of Knowledge	Poor	4	2	7	3
	Fine	20	5	18	18

Figure 10. Cross-tab analysis between Previous Knowledge and Chosen Technique to Represent Mass

Preferable techniques are also diverse into many types, although it can be concluded that variables related to light/shade and urgency to represent reality are preferred using photorealism. On the other hand, the variable of mass, which is related to scale and form is preferred to be represented using illustration and sketch.

Most respondents choose photorealism as the preferred style for showing the material and its attributes. For example, the clarity of the material is shown using a photorealism style, as respondents want to present the importance of the material to the client. This phenomenon is further strengthened by the fact that the least favorable style is sketched since the client is not guaranteed to know about the node, hatch, or pattern used in architectural representation to show different types of material [12].

Based on Figure 11, shows a strong correlation between academic years in choosing photorealism as the most preferable technique to represent material (texture, roughness, weight, and light/shade). Photorealism is also preferable in representing that quality, with a significant difference from other styles. Both sketches also sit on the least favorable since the client cannot perceive those qualities as the same as the designer intended to show. The difference in each material is not visible using sketches. Photorealism can deliver the idea to laypeople as they see it in the real world, which sketches cannot easily deliver. Photorealism can create mirror of the real-world visual perception, making it easier for students to interpret. In the other hand, sketch, painting, and illustration technique require more abstract thinking, creativity, and interpretative approach, which might be more challenging. Using photorealism techniques ensure that the information is effectively conveyed to the viewer.

		Material			
		Sketch	Panting	Illustration	Photorealism
		Count	Count	Count	Count
Level of Knowledge	Poor	2	4	4	8
	Fine	13	14	12	32

Figure 11. Cross-tab analysis between Previous Knowledge and Chosen Technique to Represent Material

Figure 12. Exterior Photorealism (ArchCGI)

Figure 13. Interior Photorealism (ArchCGI)

When it comes to delivering information about material, light and shade, color, and overall atmosphere, photorealism provides those advantages. Photorealism accommodates the immense value of visual information that is easily digested by users (people with poor knowledge about representation, which can bridge the gap between architect and designer (Figure 12 and Figure 13). With all these findings, there is a contrast with the previous study [26], as images with depth realism demonstrated a relatively insignificant impact on users' immersive understanding.

CONCLUSION

This research exposes three aspects of analyzed data which are design knowledge, architectural mass, and material. The students also tend to use different drawing styles of representation based on the design intention i.e. sketch, illustration, and photorealism. Information about mass consists of three aspects which are mass volume, three-dimensionality, and scale to deliver information about the mass volume and scale, prefer using sketch and vector. This correlates with a previous study [30], which shows that sketches stimulate active participation by facilitating a wider variety of interpretations. In contrast to photorealism, a sketch exhibits fewer details. This nature allows users to fill the absence of details with their imagination.

The exact phenomenon happens when students want to deliver information about the material (clarity, weight, and roughness). Photorealism is the most picked representation to communicate the information that users see as their eyes see in real life. This includes information on three-dimensionality. The conclusion that can be drawn is that two major types of representation are preferable, both sketches are used the most for delivering the information about shape and mass, while photorealism is used the most for showing the texture and clarity of material.

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