Nanotechnology Perceptions
ISSN 1660-6795
www.nano-ntp.com

Investigating the Correlation of Visual Literacy and Design Thinking Proficiency Among Graphic Design Students in Surabaya

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Purpose: This study investigates the intersection of visual literacy and design thinking proficiency among graphic design students, focusing on their impact on creative problem-solving.
Design/Methodology/Approach: Visual literacy, defined as the ability to understand and apply visual language, plays a pivotal role in comprehending and appreciating visual communication design. Design thinking, a user-centric problem-solving approach, involves stages such as empathizing, defining, ideating, prototyping, and testing. The research, conducted among 236 graphic design students from various universities in Surabaya, utilizes exam-based assessment technique data analyzed through SPSS.
Findings/Result: The results indicate a significant positive relationship between visual literacy and design thinking skills. The findings contribute valuable insights for educators and practitioners aiming to enhance students' holistic problem-solving abilities.
Originality/Value: This research focuses on the relationship between visual literacy and design thinking skills in the context of graphic design students.
Keywords: Visual Literacy Skills, Design Thinking Proficiency, Design Students.

1. Introduction

At the moment, images predominate in everyday activities and communication is heavily visual (Kędra & Zakeviciute, 2019). According to (Mejía & Chu, 2014; Wagner, 2017), literacy helps communication designers better grasp the social environment by bolstering the human element. As such, visual professions like architecture and visual communication design are inextricably linked to visual literacy (Benoît, 2016). Designers need to be able to comprehend the visual language in order to guarantee precise and efficient communication in visual form. Visual literacy is the term used to describe this skill. In essence, visual literacy is the ability to interpret and use a visual language for interaction and communication with others and the environment (Sidhartani, 2016). By employing visual and audio-visual resources, visual literacy in advanced understanding encompasses media literacy as well as technology literacy, fostering critical and respectable learning capacities (Setiawan & Khamadi, 2019).

Insufficient visual literacy among designers can cause misunderstandings regarding audience interpretation and the organizing process, which raises the possibility of miscommunication (Csillag, 2009). Students are taught a variety of project types in the broad subject of graphic design, such as publication, advertising, visual communication, signage development, display, and typography. Graphic designers must be creative in their problem-solving techniques because this broad sector requires them to investigate their knowledge of other cultures in a project (Alhajri, 2017).

If students lack visual literacy skills, it affects the process and outcomes of executing visual messages through their work. Students may become passive in finding visual references that can enhance the quality of their work, citing time constraints or deadlines as reasons. Student incapacity in visual literacy can result in violations of intellectual property rights, such as plagiarism or minimal modifications to existing works. This impacts both the students' reputation and the institution.

This challenge is evident among graphic design students. They tend to produce less communicative works due to a lack of understanding of the role of visual literacy in the creative process. Students often prioritize aesthetics, emphasizing attractiveness over reinforcing communicative function, contrary to the problem-solving role of design. The main issue lies in students' insufficient understanding of the dynamics of visual information development, leading to failures in conveying visual messages. The role of design as problem-solving is inseparable from students' proficiency in the design thinking process, which is one of the methods in the design process. Design Thinking is a problem-solving method focused on the user (Ambrose & Paul, 2010; Hasso, 2018). Therefore, in the design problem-solving process, especially in graphic design, students should engage in the stages of Design Thinking for the design conceptualization process.

Based on the problem formulation, attempting to understand the influence of visual literacy skills on the design thinking skills of design students, the objectives of this research are:

1. To determine the impact of visual literacy skills on the design thinking skills of graphic design students.

2. To ascertain the extent of the influence of visual literacy skills on the design thinking skills of graphic design students.

2. Literature Reviews

2.1 Visual Literacy Skills

The Association of College and Research Libraries (ACRL) has adopted a more inclusive definition of visual literacy, which comprises a set of visual skills that can be developed through sight by integrating other sensory experiences. The cultivation of these skills forms the foundation of learning. As these abilities are nurtured, an individual can attain visual literacy to distinguish and interpret activities, objects, and signs in their environment, both natural and artificial. By creatively employing these skills, one can effectively communicate with others. Creativity, which is also associated with the capacity to think innovatively by utilising technology to enhance one's understanding (Wono et al., 2023). This knowledge also

enables an understanding and appreciation of works in visual communication design (Baylen & D'alba, 2015).

The Association of College and Research Libraries (ACRL) introduces the Media Literacy model to gain insight into the stages of visual literacy skills among design students, as outlined by (Hattwig et al., 2013). Visual literacy encompasses a set of essential skills, with defining image needs serving as a foundational capability. This skill involves the adept determination of the nature and extent of visual requirements pertinent to a creative project. It encompasses the identification of relevant sources, materials, and types of visuals, along with the ability to conduct thorough research. Additionally, it involves explaining the functions and uses of visual images within their intended scope, while also fostering the generation of innovative ideas from existing visual materials. Concurrently, finding and accessing images is a critical competence, requiring the efficient location and retrieval of previously identified visual needs.

Moreover, interpreting and analyzing images constitutes a pivotal facet of visual literacy, demanding a high degree of critical thinking. This skill involves the nuanced ability to analyze and interpret the content, context, and meaning conveyed by visual images, thereby enhancing the viewer's comprehension. Subsequently, evaluating images becomes imperative, encompassing the assessment of visual elements such as effectiveness, aesthetic and technical characteristics, and textual information related to the image. The discerning evaluation of accuracy and truthfulness in the sources further refines this skill. Moving beyond analysis, effective utilization of images becomes paramount in various design contexts, including problem-solving, presentations, design projects, and exhibitions. This proficiency entails the judicious selection of relevant images aligned with the specific topic and purpose of the design. Lastly, the holistic grasp of visual literacy also incorporates the ethical and legal considerations surrounding image use, demanding an understanding of intellectual property, copyright, and the principles of fair use in conjunction with a commitment to ethical practices.

The seven visual literacy skills outlined above are interconnected, and the deficiency in one skill can significantly impact others (Setiawan & Khamadi, 2019). The ability to visually observe is particularly crucial for students in the visual literacy process. Through visual observation, students can clearly articulate visual objects, aiding in the completion of tasks within the design process (Sidhartani, 2016). The skill of defining image needs, for instance, relies on keen observation to accurately determine the nature and level of visual requirements for a given project. Moreover, effective image creation and utilization stem from a thorough understanding gained through visual observation and interpretation. Therefore, the proficiency in one skill, such as visual observation, serves as a foundational element influencing the successful execution of other visual literacy skills. Consequently, fostering the ability to observe visually emerges as a cornerstone in cultivating a holistic and interconnected set of visual literacy competencies among students.

Table 1. The Measurement of Visual Literacy Skills

No.	Sub Construct	Description	Indicator
1.	Defining image need	Fundamental visual literacy skills are explored to determine the level and nature of the visual requirements of the presented work.	1. Able to define and articulate the requirements for an image.
			2. Able to identify various sources of images, materials, and types.

2.	Finding and accessing images	It observes the skill of identifying identified visual needs and then achieving them efficiently and effectively.	1. Able to choose the best systems and sources to locate and retrieve the necessary visual media and images. 2. Able to conduct effective image searches. 3. Able to acquire and organize images and information sources.
3.	Interpreting and analyzing images	It tests critical thinking skills when observing visual images.	1. Able to identify information relevant to the meaning of the image. 2. Able to place a picture in its historical, social, and cultural context. 3. Able to identify the design elements in an image. 4. Able to validatemeaning and analyzing images from different perspectives.
4.	Evaluating images	It observes the skills to assess visual images by detailing their effectiveness, aesthetic characteristics, and, technically, textual information related to the images. It also involves evaluating the accuracy and validity of their sources.	1. Able to assess an image's readability and efficacy as a visual communication tool. 2. Able to assess both an image's technical and aesthetic qualities. 3. Ability to assess the textual data that goes with pictures. 4. Able to make evaluations regarding the reliability and validity of image sources.
5.	Using images effectively	It observes the skills to control the use of images, often applied in design articles, presentations, design projects, and exhibitions	1. Able to use images effectively for various purposes. 2. Able to use technology effectively to work with images. 3. Able to integrate images into scientific work by applying creativity, experimenting, and problem-solving skills. 4. Able to communicate effectively both about and with images.
6.	Creating visual media	The ability to "write" visually involves the creation of images.	1. Able to produce visual material for various projects and scientific purposes. 2. Able to produce images and other visual material by utilizing design principles and creativity. 3. Able to create visual media and images by utilizing a variety of tools and technology. 4. Able to assess works of art that one has made for themselves.
7.	Understanding ethical and legal issues	It investigates copyright, intellectual property rights, and acceptable usage guidelines for visual aids. It can also increase understanding of the morally and responsibly utilized visual resources.	1. Able to understand numerous economic, social, ethical, and legal issues related to images and visual media. 2. Able to follow the highest moral and legal standards when obtaining, utilizing, and producing photographs. 3. Able to reference visual materials and pictures in projects, reports, and presentations.

2.2 Design Thinking

A creative, iterative method for coming up with solutions that are viable, feasible, and appealing is called design thinking. It is a thorough process of thought that concentrates on coming up with sympathetic answers to specific needs that are based around people. The five phases of the design thinking process are empathy, define, ideate, prototype, and test. Design thinking is widely applied to promote creativity, critical thinking, and problem-solving skills in a variety of sectors, including education, architecture, and product creation. These days, one of an organization's most crucial strategic drivers is innovation, and design thinking is a useful tool for reaching this objective.

The following procedures should be followed again as necessary to generate quality work while developing a product using design thinking (Ambrose & Paul, 2010):

1. Empathize begins with empathetically understanding a problem that needs to be solved. In this step, the focus is on the user to determine what is desired by being present and face-to-face, conducting interviews, and adopting the perspective as if one were the user. This ensures that user problems can be addressed smoothly.

2. In order to determine the central issue that has to be found, the define and synthesize step is examined. The define stage helps solve user concerns since it identifies the issues beforehand.

3. Ideate produces concepts. All concepts are accepted as solutions to the problems that have been identified during the defining stage. Getting as many ideas or answers to problems as you can during this time is essential. The last phase is to investigate and test solutions to determine the best course of action or to gather the necessary components to prevent issues in the future.

4. Prototype, a number of product iterations are created at a reduced cost and size, or they incorporate particular features to find answers to issues raised in the previous stage. Prototypes are tested in groups or individually. Revisions are made in response to input in order to create a reliable and accurate prototype.

5. Test, the product has been tested and evaluated in front of the public, and changes and additions are made to the results to eliminate issues and gain a deep understanding of the product and its users.

Table 2. Measurement of Design Thinking Skills

Sun Constructs	Description	Indicator
Empathize Skills	Empathy means that designers must consider the feelings of the audience as the target (Tsai & Wang, 2020).	Able to understand the perspectives and feelings of the audience when experiencing artwork.
	It is a skill to develop and illustrate a general perspective of the problem according to what is experienced, collaboration, and thinking processes (Pande & Bharathi, 2020).	Able to describe problems.
Define Skills	It is a skill in clearly identifying the needs or problems of the user (Tsai & Wang, 2020).	Able to identify user needs.
	It is the ability to leverage existing knowledge to drive new learning (Pande & Bharathi, 2020).	Able to leverage knowledge.
Ideate Skills	It is a skill in using brainstorming and generating various creative solutions.	Able to generate various solutions through brainstorming when working on a project.
	It is the ability to generate many fresh ideas (Pande & Bharathi, 2020).	Able to generate many fresh ideas.

Prototype Skills	It is a skill to present initial ideas and showcase a model for a problem-solving solution (Tsai & Wang, 2020).	Able to demonstrate applied ideas.
	It is a skill to adapt between contexts and concepts (Pande & Bharathi, 2020).	Able to adapt between contexts and concepts.
Evaluation Skills	It is the skill to evaluate and assess the produced prototype/model (Tsai & Wang, 2020).	Able to test prototypes.
	It is the ability to summarize various perspectives to gain new knowledge (Pande & Bharathi, 2020).	Able to summarize.

3. Methodology

3.1 Design of Study

This research uses a survey research design in the form of a test that provides a quantitative description of the association between the variables visual literacy skills and design thinking skills. This type of research involves measuring variables and testing relationships between variables to reveal correlations, or causal relationships(Creswell & Creswell, 2018; Leavy, 2017).

3.2 Variables

This research focuses on two variables: visual literacy ability and design thinking ability. Visual Literacy is the ability to understand a form of visual language and apply that understanding to communicate and interact with the environment. It is crucial for comprehending and appreciating works of art, influencing an individual's capacity to create or produce visual content (Sidhartani, 2016). Visual Literacy includes determining visual image needs, searching and accessing visual images, interpreting and analyzing visual images, evaluating visual images, using visual images effectively, creating visual media, and understanding ethics and legal issues (Hattwig et al., 2013). While the Design Thinking Process is one of the methods for the design process, consisting of empathizing, defining, ideating, prototyping, and testing (Hasso, 2018).

3.3 Sample and Sampling Technique

The research sample is composed of 236 graphic design students studying at State University of Surabaya (UNESA), University of National Development (UPN) of East Java, University of Dynamic (UNDIKA) and Indonesian Institute of Informatics (IKADO). The study was conducted in the even semester of 2022-2023 academic year. The students are all in semester 4 and they have already taken a design methodology course. The reason for choosing this student semester level is the assumption that the students have already learned and understand about design methods and have enough experience in practicing design in some design course. The distribution of the study group according to university is shown in Table 3.

Table 3. Distribution of Sample

University	Male (%)	Female (%)	Total (%)
State University of Surabaya (UNESA)	49 (36,84)	43 (41,75)	92 (39,00)
University of National Development (UPN)	44 (33,08)	31 (30,10)	75 (31,78)
University of Dynamic (UNDIKA)	23 (17,29)	10 (9,71)	33 (14,00)
Indonesian Institute of Informatics (IKADO)	17 (12,78)	19 (18,44)	36 (15,22)
TOTAL	133 (100)	103 (100)	236 (100

The table presents the distribution of the sample across four different universities (Universitas

Negeri Surabaya - UNESA, Universitas Pembangunan Nasional - UPN, Universitas Dinamika - UNDIKA, and Institut Informatika Indonesia - IKADO) with regard to gender. The data is expressed in percentages, indicating the proportion of male and female participants within each university and the overall total. For instance, at UNESA, 36.84% of the sample are male, while 41.75% are female, resulting in a total of 92 participants. Similarly, the table provides similar breakdowns for UPN, UNDIKA, and IKADO. Overall, the total sample comprises 133 male participants (56.36%) and 103 female participants (43.64%), summing up to 236 individuals across all universities. This information offers insights into the gender distribution within the sampled universities, aiding in understanding the composition of the participants in the study.

3.4 Data Collection

The questionnaire dissemination approach is the data collection strategy used in this research project. Each research participant completes a questionnaire as a self-report data gathering tool for the study. To learn more about participants' opinions, feelings, attitudes, beliefs, values, perceptions, personalities, and behavioral intentions, researchers employ questionnaires. Using the questionnaire, the researcher hopes to gauge a number of traits (Johnson, R. Burke, 2014).

Table 4. Data Collection Method and Research Instrument

Data	Data Collection Technique	Instrument	Number Item
Visual literacy skills	Test	Assessment Sheet	25
Design thinking skills	Test	Assessment Sheet	30

The use of tests is used to obtain or collect primary data relating to the variables studied, namely visual literacy (X), Design Thinking Skills (Y). The Visual Literacy Ability variable instrument was developed based on the Visual Literacy Standards of the Association of College and Research Libraries (ACRL). The Design Thinking Skills variable instrument was developed based on Design Thinking by Hasso Plattner, Institute of Design at Stanford.

Meanwhile, the validity and reliability of the assessment instruments are first carried out using validity measurements based on a significance value of 0.05 and reliability based on Cronbach's Alpha values. Learning tools in the form of syllabus, learning media and teaching materials were analyzed to prepare question grids based on question indicators based on the cognitive level of Bloom's taxonomy. The design thinking assessment instrument is a multiple choice question to see students' visual literacy skills and design thinking skills. The questions are prepared based on predetermined indicators by referring to several references related to visual literacy. Questions are uploaded in form to make data retrieval easier.

3.5 Data Analysis

This research utilizes the SPSS application to analyze data and draw conclusions from the analysis results, ensuring that hypotheses and research questions can be accurately addressed. SPSS, or Statistical Package for the Social Sciences, is a software tool widely used for statistical analysis in various fields, including social sciences and research. By employing SPSS, researchers can perform a range of statistical analyses to explore patterns, relationships, and trends within the collected data.

The application of SPSS in this study facilitates the examination of the relationship between variables, the testing of hypotheses, and the generation of descriptive statistics. This software assists researchers in making sense of the data and drawing meaningful insights, contributing to a comprehensive understanding of the research objectives. The results obtained from the SPSS analysis are crucial in providing empirical support for the study's findings and enhancing the overall validity and reliability of the research outcomes.

4. Results and Discussion

4.1 Validity and Reliability Testing

Validity testing in statistical analysis, particularly in the context of SPSS, is a process to ensure that the data and the measures used are accurate and meaningful for the research. It involves assessing the soundness of the research instrument, such as a questionnaire, to measure what it is intended to measure. In the provided studies, validity testing was conducted using SPSS to ensure the accuracy and relevance of the data collected. The significance (sig) value obtained from the validity testing indicates whether the measures used in the research are appropriate. A sig value less than 0.05 is commonly used to determine the statistical significance of a test, suggesting that the results are not likely due to chance.

While, reliability testing in SPSS is a process of evaluating the consistency and stability of a measurement instrument or questionnaire. One of the most widely used measures of reliability is Cronbach's alpha, which ranges from 0 to 1, with higher values indicating greater internal consistency. The standard for Cronbach's alpha is 0.6, although values above 0.7 are generally preferred. To conduct reliability testing in SPSS, one can use the "Reliability Analysis" function, which calculates Cronbach's alpha and other measures of reliability. The function can be found under "Analyze" > "Scale" > "Reliability Analysis" in the SPSS menu.

Table 5. Reliability Test Result

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0,825	0,928	55

Table 6 presents the results of a reliability test, specifically utilizing Cronbach's Alpha coefficient. The table displays two values: the overall Cronbach's Alpha and the Cronbach's Alpha based on standardized items. The overall Cronbach's Alpha of 0.825 is indicative of a good level of internal consistency among the items within the measurement instrument. Generally, a Cronbach's Alpha value above 0.70 is considered acceptable, and a value of 0.825 suggests that the items in the test are reliably measuring the same underlying construct.

4.2 Classic Assumptions Testing

4.2.1 Normality

The term "normality" in SPSS data analysis relates to the data's distribution. A normal distribution of the data must be confirmed before running several statistical tests. To find out if the data has a normal distribution, do the normality test. The Kolmogorov-Smirnov test in SPSS is frequently used to check for normalcy. The data is considered regularly distributed if

the test's significance value is higher than 0.05. To guarantee the validity of the results, this is a requirement for most statistical studies, including regression models and t-tests.

Table 6. Normality Test

Variable	Statistics	df	Sig
Visual Literacy Skills	0,377	30	0,199
Design Thinking Skills	0,289	30	0,128

Table 6 presents the results of a normality test for two variables: Visual Literacy Skills and Design Thinking Skills. The table includes three columns: "Statistics," "df" (degrees of freedom), and "Sig" (significance). For Visual Literacy Skills, the normality test yields a statistic of 0.377 with 30 degrees of freedom, and the associated p-value (Sig) is 0.199. In statistical terms, a p-value above the commonly used threshold of 0.05 suggests that there is no significant departure from normality. Therefore, based on this result, it can be inferred that the distribution of scores for Visual Literacy Skills is reasonably close to a normal distribution.

4.2.2 Heteroscedasticity

When the variance of the residuals in a regression model is not constant across all observations, it is referred to as heteroscedasticity. Stated differently, the residuals' distribution varies among observations. This may result in erroneous model parameter estimations and compromise the reliability of the findings. When referring to the standard of sig larger than 0.05, this means that if the t-test's p-value (sig) is higher than 0.05, it cannot be used to reject the null hypothesis, which states that there is no heteroscedasticity, and the data is therefore regarded as heteroscedastic. The data is regarded as homoscedastic if the p-value is less than 0.05, which implies that the null hypothesis can be rejected.

Table 7. Heteroscedasticity Test Result

Model	Variable	Sig
1	Visual Literacy Skills	0,022

4.2.3 Multicollinearity

When two or more independent variables in a regression model have a strong correlation with one another, this is known as multicollinearity. This may cause the analysis to produce erroneous or untrustworthy results. The Variance Inflation Factor (VIF) and tolerance can be used in SPSS data analysis to evaluate multicollinearity. The amount that multicollinearity inflates the variance of a regression coefficient is measured by the Variance Inflation Factor, or VIF. Multicollinearity in the model is indicated by a high VIF value, typically greater than ten. The percentage of a predictor variable's variance that cannot be explained by the other predictor variables in the model is known as tolerance. Multicollinearity in the model is indicated by a low tolerance value (often less than 0.1).

Table 8. Multicollinearity Test Result

Model		Collinearity Statistics	
		Tolerance	VIF
1	Visual Literacy Skills	0,322	3,510

Table 8 provides the results of a multicollinearity test for a specific model, focusing on Visual

Literacy Skills. The table includes two collinearity statistics: Tolerance and VIF (Variance Inflation Factor). For the given model (Model 1) and the variable Visual Literacy Skills, the Tolerance value is 0.322, and the VIF is 3.510. Multicollinearity is a condition where two or more independent variables in a regression model are highly correlated, making it challenging to separate their individual effects on the dependent variable. In this case, a Tolerance of 0.322 and a VIF of 3.510 suggest that there is no severe multicollinearity issue. Tolerance above 0.1 and VIF below 10 generally indicate acceptable levels of multicollinearity.

4.2.4 Autocorrelation

The statistical notion of autocorrelation describes the relationship that exists between a variable and its historical values. The Durbin-Watson statistic, which gauges the degree of correlation between nearby residuals in a regression analysis, can be used in SPSS data analysis to identify autocorrelation. There is no autocorrelation when the Durbin-Watson value is 2, positive autocorrelation when it is less than 2, and negative autocorrelation when it is larger than 2. Autocorrelation can provide skewed estimates of regression coefficients and impair the validity of statistical tests. For this reason, it's critical in data analysis to identify and account for autocorrelation.

Table 9. Autocorrelation Test Result

Model	Durbin Watson
1	2,102

Table 9 presents the results of an autocorrelation test for a specific model, with the focus on the Durbin-Watson statistic. The table includes one column indicating the Durbin-Watson value for the given model (Model 1). In this case, the Durbin-Watson value for Model 1 is 2.102. Generally, a value between 1.5 and 2.5 is considered acceptable, indicating no strong evidence of autocorrelation. The value of 2.102 falls within this range, suggesting that there is no significant autocorrelation in the residuals of the regression model for the specified variable.

4.3 Coefficient Determination (R^2)

In a regression model, the coefficient of determination, or R2, is a statistical metric that shows how much of the variance for a dependent variable is explained by one or more independent variables. R2 is frequently used in SPSS to evaluate a regression model's quality of fit. An R2 value of greater than one suggests that the model fits the data more accurately; a value of 1 denotes a perfect match. It is computed as the square of the dependent variable's Pearson correlation coefficient between its observed and anticipated values. A statistical software program for interactive, or batch, statistical analysis is called SPSS.

In regression analysis, the coefficient of determination is an essential statistic that shows how effectively the independent variables account for the variability of the dependent variable. In a regression model, it is employed to assess the degree of correlation between the independent and dependent variables. An increased R2 value suggests that the independent variable(s) can account for a greater percentage of the variance in the dependent variable, and vice versa.

Table 10. R^2 Test Result

Model	R	R^2
1	0,522	0,476

The R-squared (R2) test results for a particular model are shown in Table 11. "Model," "R" (the correlation coefficient), and "R2" (the coefficient of determination) are the columns that make up the table. The percentage of the dependent variable's variance that can be predicted from the independent variable(s) is shown by the coefficient of determination (R2). An R2 of 0.476 indicates that the independent variable(s) in the model account for around 47.6% of the variability in the dependent variable.

4.4 Hypothesis Test

The results of the t-test conducted to examine the relationship between visual literacy skills and design thinking skills yielded a significant outcome, with a p-value of 0.000. This implies that there is a positive and substantial impact of visual literacy skills on the design thinking skills of students. The exceedingly low p-value indicates a strong level of statistical significance, providing robust evidence to support the hypothesis that proficiency in visual literacy positively influences one's ability to engage in design thinking processes. The findings suggest that individuals with enhanced visual literacy skills are more likely to excel in various facets of design thinking, such as empathizing with end-users, defining problem statements, ideating creative solutions, prototyping, testing, and adapting their approach based on feedback. This insight is valuable for educators and practitioners aiming to foster a holistic understanding and application of design thinking skills among students.

5. Discussion and Findings

The study conducted a t-test to investigate the relationship between visual literacy skills and design thinking skills among students, and the results yielded a highly significant p-value of 0.000. This indicates a substantial impact of visual literacy on design thinking skills, emphasizing its crucial role in the creative problem-solving process.

Firstly, strong visual literacy skills were found to significantly enhance the empathizing phase of design thinking. Students proficient in visual literacy demonstrated an enhanced ability to understand and connect with the needs and experiences of end-users, providing a solid foundation for framing meaningful problem statements. Moving to the definition phase, participants with advanced visual literacy skills were notably more precise in articulating problem statements that resonated with end-users. Clear and targeted problem definition is critical for guiding subsequent design thinking steps and ensuring that solutions align effectively with user expectations. The ideation phase benefited from heightened visual literacy as individuals demonstrated a greater capacity for creative thinking and brainstorming. Those with advanced visual literacy skills generated a diverse range of innovative ideas, enriching the ideation process and fostering a dynamic environment for solution generation.

The study underscores the integral role of visual literacy in shaping various stages of the design thinking process. The findings suggest that a focus on developing visual literacy skills can significantly contribute to enhancing students' proficiency in design thinking, providing

valuable insights for educators and practitioners aiming to foster comprehensive problem-solving abilities among students.

Visual literacy, the ability to interpret and give meaning to information in the form of images or visuals, is considered a vital skill for students. Several researchs has shown that visual literacy can lead to the development of critical thinking, communication, and creative thinking skills among students (Nida et al., 2023; Stanimirovic et al., 2023). Additionally, visual literacy is essential for interpreting information from visual sources, which is increasingly important in contemporary culture (Roberts & Philip, 2006). Furthermore, the role of visual thinking in educational development, particularly in fields such as architectural design, highlights the importance of visual literacy in fostering creativity and problem-solving skills (Stanimirovic et al., 2023).

6. Study Implications

The findings of this study hold significant implications for both academia and the design industry. Firstly, in the educational context, recognizing the strong influence of visual literacy skills on design thinking proficiency suggests that curricula and instructional approaches should be tailored to enhance students' visual literacy capabilities. Incorporating targeted visual literacy interventions within design courses can contribute to a more holistic development of students' problem-solving skills. Additionally, educators may consider interdisciplinary collaborations to integrate visual literacy training across various disciplines, fostering a well-rounded skill set in students. In the professional sphere, the study highlights the importance of recruiting designers with a robust foundation in visual literacy, as this directly contributes to their effectiveness in the design thinking process. Employers and design practitioners should value and prioritize visual literacy skills when assessing the capabilities of design professionals, recognizing its pivotal role in driving innovative and user-centric solutions.

Despite the valuable insights gained from this study, it is essential to acknowledge certain limitations that may impact the generalizability of the findings. Firstly, the research focused on graphic design students in specific universities, limiting the generalization of results to a broader population. Future studies could expand the scope by including diverse design disciplines and institutions to provide a more comprehensive understanding of the relationship between visual literacy and design thinking. Additionally, the reliance on self-reported questionnaire data introduces the potential for response bias, and incorporating qualitative methods or observational approaches could offer a richer exploration of the nuanced interactions between visual literacy and design thinking skills. Furthermore, this study primarily examined the impact of visual literacy on design thinking, and future research could explore reciprocal relationships, investigating how engaging in design thinking processes might enhance visual literacy skills. Exploring the longitudinal effects of interventions aimed at improving visual literacy and design thinking would provide valuable insights into the sustained development of these skills over time.

7. Conclusion

In conclusion, this study delved into the intersection of visual literacy and design thinking skills among graphic design students, revealing a significant positive impact of visual literacy on design thinking proficiency. The findings underscore the integral role of visual literacy in shaping various stages of the design thinking process, emphasizing its importance in fostering empathetic understanding, precise problem definition, and creative ideation. Despite certain limitations, such as a focus on specific universities and reliance on self-reported data, the study contributes valuable insights to the field. Educators, practitioners, and researchers can leverage these findings to develop targeted interventions and educational strategies that enhance visual literacy skills, subsequently bolstering students' design thinking abilities. The implications of this research extend to broader discussions on the importance of visual literacy in contemporary education and its influence on creativity, critical thinking, and problem-solving skills. This study opens avenues for future research to explore reciprocal relationships and longitudinal effects, advancing our understanding of the dynamic interplay between visual literacy and design thinking in diverse educational contexts.

References

1. Alhajri, S. A. (2017). Investigating Creativity in Graphic Design Education from Psychological Perspectives. Jurnal Arts & Humanities, 06(1), 69–85.
2. Ambrose, G., & Paul, H. (2010). Basics Design 08: Design Thinking. AVA Publishing SA.
3. Baylen, D. M., & D'alba, A. (2015). Essentials of teaching and integrating visual and media literacy: Visualizing learning. Essentials of Teaching and Integrating Visual and Media Literacy: Visualizing Learning, 1–292. https://doi.org/10.1007/978-3-319-05837-5
4. Benoît, G. (2016). The 'beautiful' in information: thoughts about visual literacy and aesthetics. Journal of Visual Literacy, 35(1), 60–78. https://doi.org/10.1080/1051144X.2016.1205831
5. Creswell, J. W., & Creswell, J. D. (2018). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (4th ed.). In Research Defign: Qualitative, Quantitative, and Mixed M ethods Approaches. Sage Publications.
6. Csillag, P. (2009). A Model Of Visual Perception Useful For Designers And Artists. Journal of Visual Literacy, 28(2), 127–144. https://doi.org/10.1080/23796529.2009.11674665
7. Hasso, P. (2018). An introduction to Design Thinking. Institute of Design at Stanford, 6. https://dschool-old.stanford.edu/sandbox/groups/designresources/wiki/36873/attachments/74b3d/ModeGuideBOOTCAMP2010L.pdf
8. Hattwig, D., Bussert, K., Ann, M., & Burgess, J. (2013). Visual Literacy Standards in Higher Education: New Opportunities for Libraries and Student Learning. Portal, 13(1), 61–89.
9. Johnson, R. Burke, and L. C. (2014). Educational Research: Quantitative, Qualitative, and Mixed Approaches (Thousand Oaks (ed.)). Sage Publications.
10. Kędra, J., & Zakeviciute, R. (2019). Visual literacy practices in higher education: what, why and how? Journal of Visual Literacy, 38. https://doi.org/10.1080/1051144X.2019.1580438
11. Leavy, P. (2017). Research Design: Quantitative, Qualitative, Mixed Methods, Arts-Based, and Community-Based Participatory Research Approaches. New York, NY: The Guilford Press. ISBN 9781462514380. 300 pp. (Paperback). In Family and Consumer Sciences Research Journal (Vol. 47). The Guilford Press. https://doi.org/10.1111/fcsr.12276
12. Mejía, G. M., & Chu, S. (2014). A Model for Visual Communication Design: Connecting Theories of Rhetoric, Literacy and Design. The Design Journal, 17.

https://doi.org/10.2752/175630614X13787503069918
13. Nida, D. F., Fadilah, M., Ardi, A., & Fajrina, S. (2023). A STUDY ON VISUAL CONTENT OF INFOGRAPHIC MEDIA HIERARCHY AS KAJIAN ISI VISUAL HIRAR. 7(2019), 880–887.
14. Pande, M., & Bharathi, S. V. (2020). Theoretical foundations of design thinking – A constructivism learning approach to design thinking. Thinking Skills and Creativity, 36, 100637. https://doi.org/https://doi.org/10.1016/j.tsc.2020.100637
15. Roberts, S., & Philip, R. (2006). The grammar of visual design. Australasian Journal of Educational Technology, 22(2 SE-Articles). https://doi.org/10.14742/ajet.1299
16. Setiawan, A., & Khamadi. (2019). Peran Media dan Teknologi Dalam Literasi Visual Seni dan Desain. Prosiding SNST Ke-10 Fakultas Teknik Universitas Wahid Hasyim, 258–263. https://www.publikasiilmiah.unwahas.ac.id/index.php/PROSIDING_SNST_FT/article/view/2888
17. Sidhartani, S. (2016). Literasi Visual Sebagai Dasar Pemaknaan Dalam Apresiasi Dan Proses Kreasi Visual. https://api.semanticscholar.org/CorpusID:193667489
18. Stanimirovic, M., Nikolic, B., Vasic, M., & Zivkovic, M. (2023). The role of visual thinking in educational development: architectural design. Journal of Asian Architecture and Building Engineering, 22(6), 3244–3252. https://doi.org/10.1080/13467581.2023.2205469
19. Tsai, M.-J., & Wang, C.-Y. (2020). Assessing Young Students' Design Thinking Disposition and Its Relationship With Computer Programming Self-Efficacy. Journal of Educational Computing Research, 59(3), 410–428. https://doi.org/10.1177/0735633120967326
20. Wagner, E. (2017). A Tool for Art Educators: The Common European Framework of Reference for Visual Literacy: Conversations Across Cultures. In Art & Design Education in Times of Change. https://doi.org/10.1515/9783110528329-019
21. Wono, H. Y., Supriaddin, N., Amin, F., Indriastuti, Y., & Sufa, S. A. (2023). Media Sosial, Literasi Digital, Dan Inovasi Bisnis Trikotomi Baru Dalam Manajemen Strategi. Branding: Jurnal Ilmiah Manajemen Dan Bisnis, October, 77–86. https://doi.org/10.15575/jb.v2i1