Mapping Research of Color in Visual Communication Design During 2011-2021

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Abstract. Color is one of the fundamental elements in visual communication design. Various research has been conducted about color related. Thus, this research was conducted to find research mapping related to color in visual communication design using bibliometric analysis methods. The data used in this study is the data contained in the Scopus database. Analysis is based on information available on the Scopus website that is collaborated with VOSViewer to visualize the results. The results of this study found that there were 377 documents related to color in visual communication design research. This amount is found after passing the screening process against the time, type of document, and subject area of research. The most type of publication document related to color in visual communication design is article document with 216 documents. The countries with the most document being in the United States with 94 documents. The affiliate with the dominating number of 6 documents is Politecnico di Milano. While research with the subject area of Computer Science has the largest percentage which is 150 documents. Mapping themes related to Color in Visual Communication Design there are four large groups which is colour, system, experiment, and participant. Mapping based on the author network there are 5 authors who network each other.

1 Introduction

Visual communication design, previously also known as graphic design, is one of the fields of applied science that continues to grow in Indonesia. The development of visual communication design can be seen from the enormous number of study program that spread throughout Indonesia. Currently, there are also many industries from various fields that require human resources with the ability in the field of visual communication design. Technically, the job in visual communication design is to collaborate between principles and visual elements. Related to visual elements, one of the important elements in visual communication design is color.

The topic studied about color also varied from research that is a study to design. Research related to color with its function as a communication tool to identify an object has been done before. Color can be used as a tool to identify changes in the aesthetic quality of an object such as a tree in each season (Mu et al., 2022). In the field of chemistry, color can be used as a chromatography concept that divides natural products, dyes, and other chemical components based on their color (Krishnan & Syed, 2022).

In visual communication design, color is used as an element to communicate. As an element of communication, color can be used is design process combined with design principles for example in infographic of public-health information (Baxter et al., 2021). Color is also able to affect a person's behavior, emotions, and social communication (Hong & Kim, 2022). The affect for example is related to the impact of color psychology on product behavior and advertising (Barnes, 2022).

From the variety of color-related research, then attracting interest for doing some research about mapping trends Color in Visual Communication Design. Thus, this research seeks to examine the mapping research about Color in Visual Communication Design. To conduct this research required a method of bibliometric analysis. Bibliometric is a type of qualitative and quantitative evaluation (Wang et al., 2021). These variables were measured using the following criteria: institutional, affiliation, productive author, subject area, source document, year of

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publication, number of copies by country, and paper citation (Maulana et al., 2021).

Document used as data to be analyzed are document in the form of scientific papers such as articles and conference papers. The use of bibliometric methods can measure and know the development of research studies on Color in Visual Communication Design research that occurs within a certain period. In this study the period used was between 2011-2021. While the data used is data on Scopus database, based on April 10, 2022

1.1 Objectives

The purpose of this study is to conduct a study of research related to Color in Visual Communication Design, based on publications in the Scopus database. The study was carried out in the 2011-2021 timeframe. This was done to review various studies that have existed related to Color in Visual Communication Design. In addition, the results of research mapping related to Color in Visual Communication Design can also present data related to various research topics that have not received enough attention. So that it can enrich research in the field of visual communication design itself. This research also used the help of VOSviewer software to visualize the results of data analysis related to the Color in Visual Communication Design research.

2 Literature Review

Color is a thing that can be seen by the human sense of vision due to the presence of light. Experiments on color were carried out by Sir Isaac Newton on white which was then refracted with a prism. The results found a variety of individual colors such as red, orange, yellow, green, blue, indigo, and violet (Mollica, 2018). These colors are also known as the seven colors of Newton or the colors of the "rainbow". There is some understanding of color as each primary color cannot be made from a color outside the primary color and the primary color can be used to create other colors. An example is as done by Albert Henry Munsell. He took an experimental approach which later resulted in five hue principles, namely red, yellow, green, blue, and purple along with colors that were in a circle that became known as The Munsell System hue circle (Best, 2017).

Color becomes one of the important elements in the design of visual communication. Visual communication design is the activity of conveying information using visual mediums. Where in it one of the elements of communication used is color (Dabner et al., 2014). Colors can produce certain effects related to certain emotions (Dael et al., 2015). In addition, colors can also be symbolized and perceived in such a way that they have a meaning that can be used in the communication process (Kaur, 2020).

3 Methods

This study used bibliometric methods. Data collection is done by identifying keywords based on Scopus publications database. This is because Scopus is one of the centers of a comprehensive database related to citations and abstracts of literature that has been reviewed (Zahra et al., 2021). Data is collected based documents search within article title, abstract, and keywords. The documents search is TITLE-ABS-KEY (color AND in AND visual AND communication AND design). The search results found 711 documents.

Restrictions are made on these results by filtering the results by year. The year used is 2011-2021. The document search then developed into TITLE-ABS-KEY (color AND in AND visual AND communication AND design) AND (LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011). From these keywords 444 documents were found.

The result subsequently filtered by the type of document, that is based on articles and conference papers. The results obtained 377 documents with the document search by TITLE-ABS-KEY (color AND in AND visual AND communication AND design) AND (LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEAR, 2016) OR LIMIT-TO (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2014)
OR LIMIT-TO (PUBYEAR, 2013) OR LIMIT-TO (PUBYEAR, 2012) OR LIMIT-TO (PUBYEAR, 2011) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp").
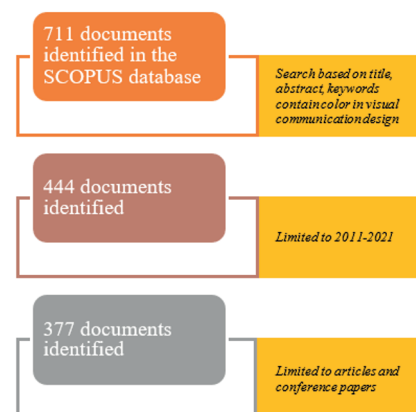

Fig. 1. Data Collection

4 Data Collection

Based on a search on the Scopus database, 711 documents were found related to the title, abstract, and keywords containing the word Color in Visual Communication Design. Then data restrictions were carried out on the time range, namely 2011-2021. Of these restrictions found 444 documents. Restrictions were then re-imposed, namely on articles and conference papers, resulting in 377 documents that were used as data for analysis. These 377 documents were then extradited in RIS format for processing with the help of VOSviewer software.

5 Result and Discussion

5.1 Documents by Years of Color in Visual Communication Design

The number of Color in Visual Communication Design documents from 2011-2021 in Fig. 2 shows an upward trend every year. Although there have been several downturns in 2012 and 2016, but from 2017 to 2021 the trend is increasing. A significant number of increases were seen in 2021, compared to 2020.

In 2011 the number of documents is 25 documents. This number have decreased in 2012 which is 21 documents. In 2013 the documents have been increased to 25 documents. The documents have a fixed number in 2014 and 2015 which is 30 documents, and decreased 2016 and fix until 2017 in 28 documents. The number of documents has been increased until 2021 from 2018 with 35 documents, 2019 with 43 documents, 2020 with 48 documents, and 2021 with 64 documents.
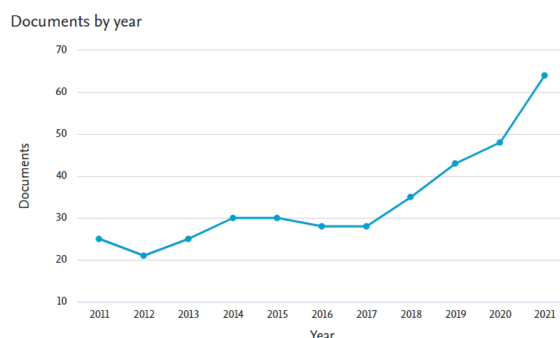

Fig. 2. Documents by year 2011-2021

5.2 Documents by Type of Color in Visual Communication Design

The results of data analysis from the search of Color in Visual Communication Design showed that most of the documents were article with 216 documents (57,3%) than conference paper with 161 documents (42,7%).
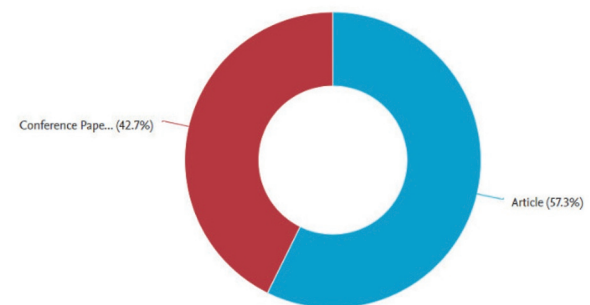

Fig. 3. Documents by type

5.3 Documents per Year by Source of Color in Visual Communication Design

Publications related to Color in Visual Communication Design documents based on the results of analysis of documents per year by source found the 5 highest sources.

Lecture Notes In Electrical Engineering (the publication shown as a blue line in Fig. 3)

In 2016 this publication has 3 documents relate to Color in Visual Communication Design. This number increased in 2018 and the publication have 4 documents. In 2020 the documents decreased to 3 documents. But increased in 2021 with 5 documents.

Lecture Notes in Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bionformatics (the publication shown as an orange line in Fig. 3)

In 2012 this publication has 1 document relate to Color in Visual Communication Design. This number continuously consistent until 2017, which is 1 document per year. In 2019 the number increased with 2 documents and consistent until 2021.

IEEE Transactions on Visualization And Computer Graphics (the publication shown as a red line at Fig. 3)

This publication related to Color in Visual Communication Design in 2014 with 1 document. It would be 2 documents in 2016 and decreased to 1 document in 2017. In 2018 the publication consistent with the number which is 1 document. But in 2019 the number increased in 2 documents and consistent until 2020. In 2021 the number decreased in 1 document.

Proceedings Of SPIE The International Society for Optical Engineering (the publication shown as a purple line at Fig. 3)

The publication has a document relate to Color in Visual Communication Design in 2011 is 4 documents. But the number is decreased to 1 document in 2012 and consistent until 2013. The

number of documents increased in 2015 to 2 documents and continuously decreased to 1 document in 2016. This number consistent until 2017. After 2017 the publication does not have any publication relate to Visual Communication Design until 2021.

ACM International Conference Proceeding Series (the publication shown as a green line at Fig. 3)

The publication has a document relate to Color in Visual Communication Design in 2013 is 1 document. This number is continuously consistent until 2016. The documents is increased in 2019 which is 2 documents and decreased in 2020 with 1 document until 2021.
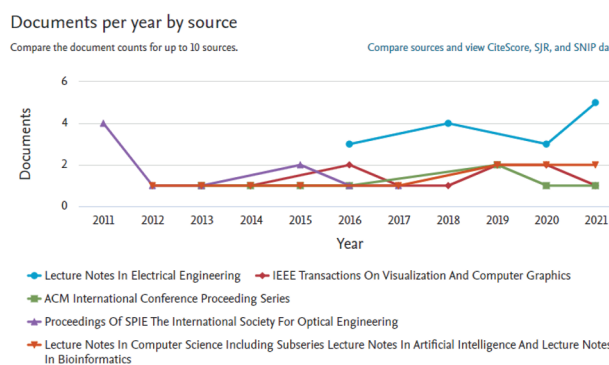

Fig. 4. Documents per year by source

5.4 Documents by Country/Territory of Color in Visual Communication Design

There are 10 countries as the top country or territory with Color in Visual Communication Design related documents. In the first place there are the United States with 94 documents. The second is China with 83 documents. The third is United Kingdom with 23 documents. The fourth is Taiwan with 18 documents. The fifth is Australia with 17 documents. The other countries is South Korea with 17 documents, India with 15 documents, Canada with 13 documents, Germany with 13 documents, and Italy with 13 documents. The United States is the country with the highest Color in Visual Communication Design documents related which is 94 documents.
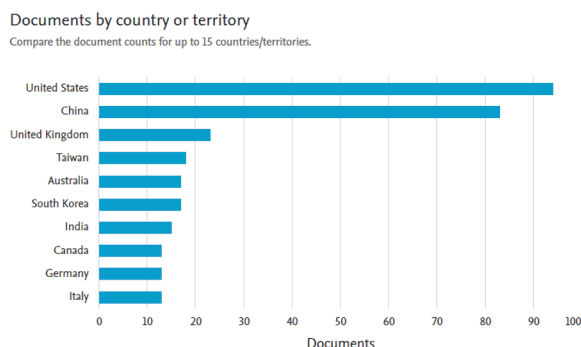

Fig. 5. Documents by country or territory

5.5 Documents by Affiliation of Color in Visual Communication Design

There are top 10 affiliates of the data related to the Color in Visual Communication Design documents. The affiliates are Politecnico di Milano with 6 documents. University of Wisconsin-Madison with 6 documents. South China University Technology with 5 documents. Pennsylvania State University with 4 documents. Massachusetts Institute of Technology with 4 documents. The University of Tokyo with 4 documents. The University of Queensland with 4 documents. Beijing Institute of Graphic Communication with 4 documents. Bina Nusantara University with 4 documents. Universidade de Lisboa with 4 documents.
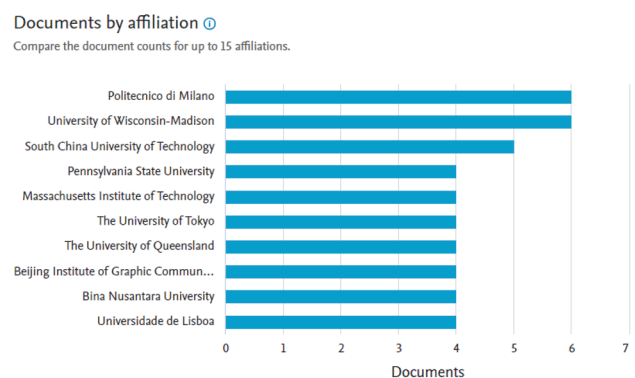

Fig. 6. Documents by affiliation

5.6 Documents by Subject Area of Color in Visual Communication Design

The subject area of the documents related with Color in Visual Communication Design from SCOPUS database during 2011-2021 saw several dominant area subjects. Subject area in the field of Computer Sciences dominates with 150 documents (21.4%). The second dominance is occupied in the fields of Engineering with 143 documents (20.4%), then in the fields of Social Sciences with 64 documents (9.1%). Further in the field of Mathematics with 45 documents (6.4%), Medicine with 34 documents (4.8%), Physics and Astronomy with 32 documents (4.6%), Agricultural and Biological Sciences with 30 documents (4.3%), Arts and Humanities with 25 documents (3.6%), Materials Sciences with 24 documents (3.4%). Business, Management and Accounting with 23 documents (3.3%).

The rest are in several other subject areas with 132 documents or 18.8%. The detailed other subject areas is Environmental Science 17 documents, Biochemistry, Genetics and Molecular Biology 14 documents, Earth and Planetary Sciences 14 documents, Psychology 14 documents, Chemistry 12 documents, Chemical Engineering 11 documents, Energy 11 documents, Decision Sciences 10 documents, Neurosciences 7 documents, Health Professions 6 documents, Multidisciplinary 5 documents, Nursing 4 documents, Dentistry 3 documents, Economics, Econometrics and

Finance 2 documents, Immunology and Microbiology 1 document, and Veterinary 1 document.
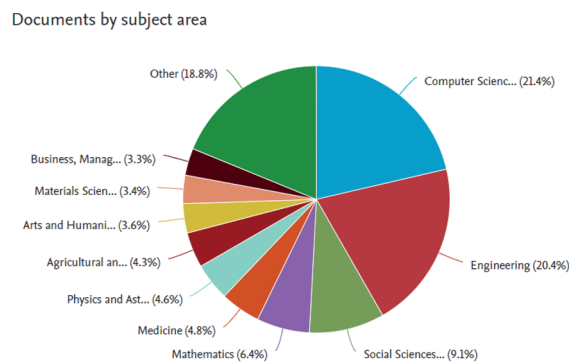
Documents by subject area

Fig. 7. Documents by subject area

5.7 Documents Most Cited of Color in Visual Communication Design

The calculation of document citations related to Color in Visual Communication Design found 10 documents with the highest number of citations in every year. From 2011 until 2021 the document with the highest number of citations in each year is:

"Honeybees as a model for the study of visually guided flight, navigation, and biologically inspired robotics"
This document published in 2011 in Physiological Review 91(2) and have 146 citations. The research related with the keyword "communication", "color", "design", and "visual" in the abstract and indexed keywords (Srinivasan, 2011).

"Anodic coloring of titanium and its alloy for jewels production"
This document published in 2012 in Color Research and Application 37(5) and have 34 citations. The research related with the keyword "color", "design", "visual", and "communication" in the abstract and indexed keywords (Diamanti et al., 2012).

"The influence of visual packaging design on perceived food product quality, value, and brand preference"
This document published in 2013 in International Journal of Retail and Distribution Management 41(10) and have 94 citations. The research related with the keywords "visual" and "design" in the abstract and indexed keywords (S.T. Wang, 2013).

"Adaptive optoelectronic camouflage systems with design inspired by cephalopod skins"
This document published in 2014 in Proceedings of the National Academy of Sciences of the United States of America 111(36) and have 156 citations. This research related with the keyword "color" in the abstract and indexed keywords (Yu et al., 2014).

"Signal design and courtship presentation coincide for highly biased delivery of an iridescent butterfly mating signal"
This document published in 2015 in Evolution 69(1) and have 47 citations. This research related with the keyword "color" in the abstract and indexed keywords (White et al., 2015).

"Enhancing understandability of process models through cultural-dependent color adjustments"
This document published in 2016 in Decision Support Systems 87 and have 40 citations. This research related with the keywords "color" and "design" in the abstract and indexed keywords (Kummer et al., 2016).

"Modeling and understanding visual attributes of mental health disclosures in social media"
This document published in 2017 in Conference on Human Factors in Computing Systems – Proceedings 2017-May and have 50 citations. This research related with the keywords "visual" and "color" in the abstract (Manikonda & De Choudhury, 2017).

"To cross or not to cross: Urgency-based external warning displays on autonomous vehicles to improve pedestrian crossing safety"
This document published at 2018 in Proceedings – 10th International ACM Conference on Automotive User Interfaces and Interactive Vehicular Applications, AutomotiveUI 2018. This document has 45 citations. This research related with the keyword's "design" and "communication" in the abstract (Li et al., 2018).

"Mapping Color to Meaning in Colormap Data Visualizations"
This document published in 2019 in IEEE Transactions on Visualization and Computer Graphics 25(1) and have 29 citations. This research related with the keyword's "color" and "visual communication" in the abstract and indexed keywords (Schloss et al., 2019).

"Communication of IPCC visuals: IPCC authors' views and assessments of visual complexity"
This document published in 2020 in Climatic Change 158(2) and have 10 citations. This research related with the keywords "visual", "communication", and "design" in the abstract and indexed keywords (Harold et al., 2020).

"Benefits of street sun sails to limit building cooling needs in a Mediterranean city"
This document published in 2021 in Building and Environment 187 and have 6 citations. This research related with the keyword "visual communication" in the abstract and indexed keywords (Garcia-Nevado et al., 2021).

5.8 Mapping Theme of Color in Visual Communication Design

To see the mapping of the theme of Color in Visual Communication Design, VOSViewer software is needed. VOSViewer is done to visualize maps based on text data sources based of terms from title and abstracts. There are four group of research themes:

Colour. Red groups "colour" have networks with product, form, element, principle, theory, consumer, message, designer, layout, line, possibility, education, perspective, project, text, web, graphic, life, composition, public, art, reference, researcher, meaning, education, and others.

System. Blue groups "system" has networks with performance, texture, problem, algorithm, application, issue, sensor, location, light, architecture, effort, navigation, mean, efficiency, range, problem, and others.

Experiment. Yellow groups "experiment" has networks with contrast, pattern, display, response, insight, condition, signal, movement, brightness, variation, speed, selection, and others.

Participant. Green groups "participant" has networks with influence, symbol, emotion, implication, group, task, activity, case study, set, interview, impact, child, and others.
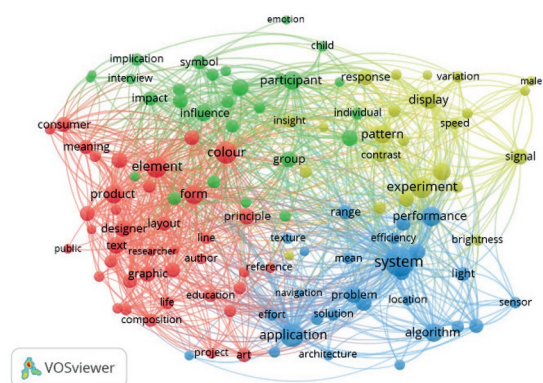

Fig. 8. Mapping theme

5.9 Author Publication Network of Color in Visual Communication Design

Based on VOSViewer map based on bibliographic data found 1073 authors with a minimum number of documents of an author is 4. There are 7 authors meet the threshold with documents related to Color in Visual Communication Design. There is Chen, G; Wang, Y; Yuan, J; Wang, J; Li, Y; Liu, Y; Wilkinson, K.M. For each of the 7 authors, the total strength of the co-authorship links with other authors will be calculated. The resulting calculation is that 5 authors have a network which is Wang, J; Yuan, J; Wang, Y; Chen, G; and Li, Y.
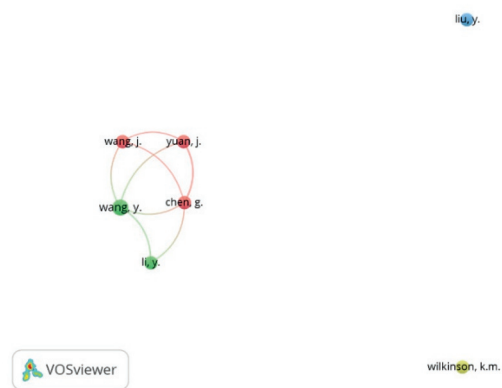

Fig. 9. The author publication network

6 Conclusion

Based on the exposure of the above data to documents related to Color in Visual Communication Design sourced from SCOPUS database found a few results. The first result is that a document related to Color in Visual Communication Design shows an increasing trend, especially starting from 2018 to 2021. In 2017 there were 30 documents that continued to increase to 64 documents in 2021.

The dominant type of document is articles with 216 more documents compared to conference papers which only amount to 161 documents. The largest source of documents is in the publication of Lecture Notes In Electrical Engineering, which is 15 documents throughout 2016 to 2021. The country with the most documents is the United States with 94 documents. The affiliate with the dominating number of 6 documents is Politecnico di Milano. Related to the Color in Visual Communication Design document, the most area subjects are in the field of Computer Science with a percentage of 21.4% or 150 documents. The document with the most citations was Adaptive optoelectronic camouflage systems with design inspired by cephalopod skins in 2014 with 156 citations. Mapping themes related to Color in Visual Communication Design there are four large groups, namely colour, system, experiment, and participant. While mapping based on the author network there are 5 authors who network each other.

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