A Phenomenological Analysis of The Experience of Analogical Thinking in Graphic Design Elaborations

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Abstract: Analogical thinking is one of the thinking processes that is associated with creativity. This paper explores how it is experienced in Graphic Design elaborations using Computer Graphic Technology (CGT). Data are collected through concurrent and retrospective probing from three undergraduates and analysed through phenomenological reduction to identify the constituents and elements of the creative analogy's general psychological structure. The findings show that the general structure of the creative analogical experience is a relationship between three constituents namely 1) the experience of recalling knowledge or information, 2) the use of knowledge for ideation and 3) the use of knowledge to conclude ideas. The findings also show that the underlying elements of these constituents are conceptual(declarative) and technical(procedural) knowledge and its combinations that are consistent with the theories of analogical thinking. This article concludes with recommendations for future research and insights on its implementation in Design Education.

Keywords: Analogical thinking, creative process, experience, graphic design, phenomenological analysis

1. Introduction

Creative processes in Graphic Design informs how designers creatively think. Divergent thinking is a common concept that is useful to assess creativity due to its reliability in predicting creative potential (Runco & Acar, 2012). Meanwhile, others suggest that creativity is also analogic (Holyoak & Thagard, 1995; Choi & Kim, 2017). The various explanations and conceptions of creative processes imply its specificity within certain contexts.

However, research on the experience of the creative process in graphic design, primarily through Analogy and Computer Graphics Technology (CGT) is scarce. Perhaps this is due to the symbolic nature of the analogical process that requires interpretation. And therefore, it is a stark contrast to quantitative measures that dominates creativity research (Long, 2014). Understanding the experience of Graphic Design elaborations might yield valuable insights into the creative processes within the context of CGT as its tools. Thus, this article aims to provide descriptive phenomenological findings on the experience of creative processes with CGT during the process of elaborations in Graphic Design. Subsequently, through the results, critical dialogue with the literature on creative processes is discussed.

2. Literature Review

Past studies and suggestions link cognition with graphic or visual perception such as recognising visual displays as a piece of indirect information (Bruner, 1964) and the primary ability to recognise spatial orientation and closure that suggests the distinction between visual and auditory skills (Thurstone, 1950). Another suggestion is that visual perception is an isomorphic interaction between problems and objective characteristics (Sharps & Wertheimer, 2000). However, elaborations in graphic design are more than just perceiving. The cycle of creating, perceiving and refining visuals shows how a lot of thought or processes is invested and therefore signify its complexities.

2.1 Declarative and Procedural Knowledge

From perceiving images—either figuratively or symbolic— to creating and designing shows that the relationship between Designers and their elaborations is historical (Dasgupta, 2019). Artefacts are produced based on the transformation of ideas with the use of appropriate technological skills. This indicates that along the period in which elaborations occur, information is added, transformed, and combined.

In the context of this study, Graphic Design Elaborations benefits from domain-relevant information. This information is represented as declarative and procedural knowledge and is a component in creative cognition (Runco & Chand, 1995). For instance, designing visuals requires the comprehension of visual theories (declarative knowledge) and the use of CGT skills (procedural knowledge) to allow elaborations to occur. This denotes that several types of knowledge are retrieved either from memory or through learning new ones, and its combinations and transformations are the phases of the Graphic Design process that either produces ideas or solutions. This study holds the position that there is a pattern to describe the interplay between declarative and procedural knowledge. Evidence of this phenomenon is shown through the improvement of design processes with CGT skills as compared to traditional methods (Howe, 1992).

2.2 Analogical Thinking

The use of relevant knowledge and its transformations is comparable to the process of selection and mapping that are commonly associated with analogical thinking (Holyoak & Thagard, 1995; Gick & Holyoak, 1983). Moreover, the interest of analogy in the design practice remains relevant through studies such as the effects of analogical distance towards ideation (L.Jia et al., 2020), its training to improve design creativity (Alipour, 2020) and adopting its concepts to the fields of artificial intelligence and data science in creating data-driven design systems(Jiang et al., 2021).

In graphic design elaborations, this process can be represented by the induction of one visual conception to another for ideas, or to a specific CGT skill to figure out solutions. This process enables combinations and transformations of knowledge into ideas or planned elaborations. Therefore, this study is framed based on the notion that during the design process, analogical thinking is experienced through the selection of relevant information (concepts or CGT skills) and its transformation to ideas and solutions through mappings. This is the main interest of this study, and the findings contribute to the understanding of the Graphic Design process towards ideation.

3. Method

This study frames the Graphic Design process with CGT as an analogical experience. This meant that analogical thinking is called into *'being'* and experienced during the design process. Therefore, an idiographic interpretation that is holistic is required. Phenomenology is suitable for Design research as the analysis methods are believed to be similar to the framing of design solutions and problems (Dorst, 2011). Moreover, phenomenology is suited to understand design from within the

practice (Findeli, 2001). Due to experience as an object of study, this research is conducted based on a modified Husserlian approach to Phenomenology (Giorgi, 2015).

This study selected three participants (P1, P2 and P3) from an undergraduate Graphic Design course. Participants are required to undergo three design tasks, and they are free to choose between two types of CGT, either Adobe Photoshop or Adobe Illustrator. The use of the internet as a source for inspiration is allowed. Task 1 requires the participant to choose one among Ten Malay Proverbs as stimuli for visualisation using CGT. In Task 2, instead of proverbs, the task requires the participants to seek quotes or sentences from popular media such as movies or musical lyrics as stimuli. Task 3 requires the participant to design an album artwork using CGT.

For data collection, two kinds of Protocol analysis, namely concurrent and retrospective probing, are used in this study (Ericsson & Simon, 1980). These two methods secure a complete engagement with the phenomena based on how the participants made sense of their design process. Verbalised data are audio-recorded and transcribed.

The phenomenological reduction is used as an analysis procedure. The reduction includes four steps of the descriptive phenomenological method (Giorgi, 2015). The steps are 1) repeated reading of the transcript getting the sense of the experience, 2) data is organised into meaning units, 3) the fulfilment of the meaning units with psychological dimensions, and 4) the description of the psychological structure. Within this reduction, categories are developed based on several processes of coding procedures. Some examples of P3 in the third task are given below:

Table 1. An example of the coding process within the phenomenological reduction

First Cycle	Second cycle (identify meaning units)	Third Cycle (psychological dimension)
Declarative or conceptual Knowledge *"I tried to do it with a minimalist style, most of the album artwork never implemented it"*	Conceptual Combinations *"people right now have an interest in minimalism, and when it is viewed on the interface of the Spotify App, it looked good. It is the current trend"*	Ideation *Minimalism, Spotify, the current trend is used to define a concept*
Procedural or Technical Knowledge (CAD skills) *"I thought I have to blend it step by step"*	Technical Combinations *"I thought I have to blend it step by step, and then it gradually led to gradient tool."*	Ideational closure *Implement an eclectic mix of concepts such as Malaysian cultures, and implement using CAD features(eg. blend and gradient tool).*
	Technical and conceptual combinations *"The concept involves a bit of Malaysian cultures, so it is an eclectic mix. And I implemented it just like that and I stylized it using certain CAD features"*	

All of the data are coded based on the example given above. On the left column, the first cycle of coding is used to identify meaningful data that represents an *analogical selection*. This is done through the identification of verbalized information that represents procedural or declarative knowledge. In the middle column, any data that is interpreted as *analogical mapping* is coded into knowledge combinations. The right column is based on the result of the first and second cycle of the coded data

and added with a psychological dimension that relates to ideation. In between cycles, datasets of the participants are triangulated to reveal the general structure of the experience, its constituents and elements, and its relationships. After the data is analysed, a session of member checks with the participants is conducted to ensure confirmability (Lincoln & Guba, 1985). This ensures that the findings depict an accurate reflection of the participants' experience when designing.

4. Results

Phenomenology is a study of experience, and commonly, it is presented through the summary of each of the participants' experiences. However, this requires a lengthy article. Therefore, some reports are omitted. Despite the limitations of this paper, the results and findings are still demonstrative of the phenomenological reduction.

4.1 General Psychological Structure

From the summary of P1, P2 and P3 lived experience when designing, the design process with CGT is complex and involves various kinds of situations and shows the vivid representation of thinking in terms of seeking ideas and finding solutions. The overall experience of the participants is retold in the paragraph that follows:

> The beginning of the experience usually starts by *using concepts* that correspond to the stimuli. The participants retrieve concepts from memory such as experience, personal knowledge, or other resources such as the internet. These concepts and technical skills are used solely or in combination and lead to several responses. The experience of *combining concepts* usually leads to *ideation,* whereby several retrieved concepts are attached to the stimuli revealed through elaboration. Concepts are also used by the participants to evaluate the artwork and set forth the use of technical skills to predict and plan the following elaboration procedures. Concepts and techniques are also revealed to be used in *combination for ideational closures*. Concepts that do not match show mishaps and can invoke the use and retrieval of a different one. Concepts and their combinations rely on the continuity and availability of technical skills. Proper techniques will result in the creation of visuals for evaluation or in another extreme might hinder elaboration if it is inadequate or absent.

Three constituents that are crucial to the creative experience of Graphic Design with CGT is discerned from the general structure above. The constituents are 1) The retrieval or use of knowledge, either its conceptual, skills or *using concepts*, 2) combining concepts that encourage *ideation*, and 3) knowledge combinations that lead to ideational *closure*. These constituents are revealed through the identification of meaning units which will be discussed in the next subsection.

4.2 The Psychological Constituents and Elements

The constituents mentioned in the previous section accounts for the whole phenomenon. It is required from a phenomenological standpoint to explain how these constituents are *'lived'* by the participants. Hence, this section provides the content of the experience or constituents, revealed through the elements based on meaning units. Table 1 reports some of the meaning units that had been identified from P1, P2 and P3.

Table 2. The reduction of data that forms the constituents

Constituents	P1	P2	P3
1. The retrieval or use of knowledge	*Conceptual*: Apocalyptic, cubism, playing video games, empty-space, surrealism, hippie, high, slender man, 'Rock-and-roll.' *Technical*: The use of Adobe Illustrator, Improvisation, visual cues as a guide	*Conceptual*: skeletal figure, lightings, shadows, good enough, it is something different, feel, personal connection, typography *Technical:* hand-sketching, Adobe Photoshop [brush tool, 'always a way out'], Adobe Illustrator, visual cues as a guide, lack of skill in typography, color palettes, 'mix and match strategy',	*Conceptual*: socio-political issues, 'cause and effect', 'wars and the endangered environment caused by politicians', 'chaotic', 'confused', organizations, order, minimalist, 'Spotify'. *Technical:* Adobe Illustrator [pen-tool, gradient tool, blend tool, stroke effects], sketch, visual cues as a guide
2. Combining knowledge for ideation	*Conceptual combinations*: P1 combines the concept of 'cubism' with 'apocalyptic' that he remembers from playing games (task 1). *Conceptual combinations*: P1 combines the concept of 'hippie', 'surrealism', 'high', 'human figure' (task 2) *Conceptual Combinations:* P1 combines 'the reaper', and 'slender man' after additional information on 'originality' is attained through discussions with the researcher. (task 3) *Technical and conceptual Combinations*: 'improvisation' on adobe illustrator	*Conceptual combinations*: P2 tries to combine skeletal figures, lighting and shadows, typographic grid (task 2) *Conceptual combinations*: seeking inspiration from the internet, YouTube videos, searching the meaning for a song, to get the 'feel', concepts from past experiences of viewing artworks of other people(task 3) *Technical combinations*: Photoshop [brush tool, 'always a way out', 'changes can easily be made'], 'mix and match' strategy.	*Conceptual combinations:* P3 tries to narrate socio-political issues that depict wars, politics and the environment (task 1). *Conceptual combinations*: P3 interprets stimuli as 'chaotic' and 'confused', typography[organization, order, serif, curvature, san-serif, rigid], remembers concept from games (task 2) *Conceptual combinations*: minimalism, 'Spotify', current trend, geometric (task 3) *Technical combinations*: Illustrator [‘blend tool', 'stroke effects', 'gradient tool'] *Technical and conceptual combinations*: explore, eclectic mix of techniques and concepts
3. Combining knowledge for closure	*Conceptual combinations:* P1 links' hippie', 'surrealism' and being 'high' as a	*Technical and conceptual combinations:* P2 chose to use another proverb as it is technically much easier (task 1).	*Conceptual combinations:* socio-political issues, politics, environment coincides with the narrative of 'cause and effects' (task 1).

	concept of the psychedelic era of the mid-1960s (task 2) *Conceptual Combinations*: P1 combines concepts from the prior art ('agents of fortune') and its perceived iconic status among the fanbase (task 3). Technical and concepts combinations: the use of features based on produced ideas (task 1)	*Technical and conceptual combinations:* P2 states that visual references from the internet make designing the proverb easier (task 1). *Technical and conceptual combinations:* hatching, lightings and shadows coincide with the use of Adobe Photoshop [brush tool]. *Conceptual combinations:* the idea of 'it might look nice', 'it is something different' or 'good enough' to evaluate designs (task 2). *Technical and conceptual combinations:* Using Adobe Illustrator as it is more suitable for measurements (task 3)	*Conceptual combinations:* 'chaotic' and 'confused' does not bode well with organization and order (task 2). *Conceptual combinations:* Minimalism and Spotify coincides with the current trend. *Technical and conceptual combinations:* simplifying 'guitar' to make it look geometric. *Technical and conceptual combinations:* experimentation with only 'blend tool', 'stroke effects'.

In table 2, the identification of the constituents can be traced to the meaning units. Therefore, one can see the reduction of raw data; the constituents are based on the elements, which itself is formed based on the meaning units. To summarize, each of the constituents had common elements of *technical* or *conceptual knowledge* and the *combination* of these two.

4.3 Interconnection Among the Constituents

So far, the findings include the constituents and their elements of technical and conceptual knowledge. The next subsection adds a psychological dimension to the results to explain the relationship between the constituents.

4.3.1 Constituent 1: The experience of recalling knowledge.

Constituent 1 is identified in this study after various types of knowledge is verbalized throughout the data. Therefore, this constituent involves the experience of knowledge recollection from working and long-term memory. Concrete conceptual understanding is used, such as *cubism*, *surrealism*, and *minimalist* by P1 and P3, to draw inspiration. These bits of knowledge are concrete concepts as it yields an accurate depiction of a visual style. Other concrete concepts are recalled based on the precise description of objects that the participants intended to elaborate upon, such as *empty-space*, *typography*, *shadows*, *lightings*, *order,* and *organizations*. These are concepts that represent their literacy in adjusting or elaborating visual elements such as texts and images. Knowledge can also be sourced from the internet. P1 and P3 also retrieved concepts from a fictional character' *slender man*' and the app '*Spotify*'. P2, on the other end, use *YouTube videos* and language translation websites to retrieve knowledge and information.

Some concepts that are used or recalled are somewhat abstract, meaning that the concepts are rather contextual. Therefore, the participant requires additional knowledge and interpretation for it to be used. P1 explains in task 2 of his attempts to implement abstract concepts of '*hippie*' and '*high*' and believed it is contextually suitable to represent the '*rock-and-roll*' genre. This concept is chained or tied together along with the idea of the band '*the Beatles'*. This shows that abstract concepts are added and accumulate towards a higher visual whole or structure. This is similar to P3 in which his depictions of a *political figure*, *wars* and *natural environment* that is tied to his concept of *'cause-and-effect*' in task 1, and the idea of '*chaotic*' and '*confused'* in task 2. The groupings of these concepts to represent a singular visual style also show that knowledge is recalled or can be constructed into schemas.

Another form of knowledge involved is technical skills and is mainly exhibited with CGT tools. P1 and P3 mostly did their work on Adobe Illustrator while P2 uses Adobe Photoshop. Not much detail is obtained other than the use of certain features such as '*color palettes*', '*stroke effects*', '*brush*', '*pen*', and '*gradient*' tools. As with the design process and elaborations, the participants tend to have an abstract interpretation of design procedures. P1 mentioned that his design process is an "*improvisation*" while P2 said the use of the "*mix and match*" strategy. P3, on the other end, mentioned a slang that meant an *eclectic mix of concepts and techniques*. This shows that technical skills or knowledge can also be in the form of concrete or abstract especially when it is related to a whole design or elaboration procedure.

4.4.2 Constituent 2: Knowledge Combinations for Ideation.

Constituent 2 is identified as the use of knowledge and its combination for planned elaboration. The mix here means that it is used to visualize the 'overall look' of the artwork. In other words, concepts are combined to produce a visual object or in depicting the general form of the artwork. This allows the participant to construct the 'parts' and 'whole' of the artwork. For instance, in task 2 of P1, his understanding of a 'hippie' visual style is combined with 'surrealism' to achieve a 'whole'. Like P3, in task 2, his combination of the abstract concept of '*chaotic*' and '*confused*' forms a visual whole; and the '*organization*' and '*order*' of typography as its visual parts. The result of these combinations are ideas that provide a plan of action for elaboration on CGT.

4.4.3 Constituent 3: Knowledge combination to conclude ideas

Constituent 3 is an experiential process of closing out ideas or *ideational closure*. These are identified as ideas at specific points that need to be evaluated for appropriation. This constituent also uses knowledge from *constituent 1* and at the same time goes along with *constituent 2*. As is seen through P1 in task 2, concepts are narrowed towards the visual styles of the psychedelic era of the mid-1960s. And in task 3, his use of prior art — album art of "*agents of fortune*" — is rationalized because of its iconic status to the fanbase of the band *'Blue oyster cult'*. Similarly, to P3 in task 1 which he narrowed several concepts to the narrative of "*cause and effect*" and how he believed *'minimalism'* and the visual style for the app *'Spotify'* is suitable to represent the current visual trend in digital music. These are examples of ideational closure that is based on the notion of an appropriate wholeness of a particular visual style.

Technical knowledge provides an outlet for ideas when designing with CGT. For instance, instead of noting a variety of technical features, P2 only exhibit the use of tools and skills that is associated with '*brushes*' on Photoshop such as '*hatching*' to visualize '*lighting*' and '*shadows*'. When Adobe Illustrator is used, P2 felt that ideation is hindered. When asked about the differences between Adobe Photoshop and Adobe Illustrator, she mentioned that familiarity with Adobe Photoshop provides "*a way out*" and how "*changes can be made easily*". This shows that although concepts are combined, and ideas are produced, it rests on the availability of technical skills. If skills are not available, ideas cannot be implemented. This shows a relationship between the use of CGT with ideational closure.

4.4.4 The relationship among the constituents

The constituents are presented separately to give clarity towards the experience as processing components. These constituents are parts of a more extensive process, just as ideation is a part of a larger design procedure that includes visual research and implementation. And therefore, based on the results presented, each of the constituents is regarded as a part of a larger general psychological structure.

5. Discussion

The following discussion is a critical correspondent with theories of Creativity, mainly analogical thinking. The discussion will cover the result of the phenomenological analysis and the past literature on creativity. Although creativity can be described in many ways according to expertise, the theories that will be discussed is considered relevant by the researcher towards the context of Graphic Design and CGT.

5.1 Constituent 1: knowledge representation

The findings resemble the use of declarative and procedural knowledge and are consistent with the suggested components of creativity and cognition (Runco & Chand, 1995). Conceptual or declarative knowledge in this study is represented in two ways. Firstly, knowledge is used through an analogical representation and secondly through symbolic representation (McNamara, 1994). P1 and P3 mainly used bits of knowledge that are analogical. Concepts such as *'minimalism'* or *'cubism'* present attributes in the mind that becomes a constraint for their intended visualizations. The mentioned concepts provide an analogical structure, which in turn enable evaluation. On the other end, P2, in some instances, uses symbolic representations to evaluate the quality of her artwork. For example, the notion of "*it might look nice*" or "*something different*" represents an uncertain and arbitrary internal structure that is symbolic.

Procedural knowledge or *know-how* is exhibited mostly during the elaboration process. The use of *'brush tool'*, *'stroke effects'* and *'gradient tool'* for example, is exhibited when the procedures of elaboration are made explicit (e.g., viewing screen recordings or verbalized during the design process takes place). At times, procedural knowledge is made available even before concrete ideas are in place

(e.g., elaboration begins by tinkering with tools rather than searching for ideas through sketching). This shows that procedural knowledge can precede the use of declarative knowledge (Pezzulo, 2011). An example of the use of procedural knowledge is when P2 decides to work on a proverb after several sketches are produced and how P2 and P3 accurately mentioned CGT tools such as *'brush tool'* and *'gradient tool'*. However, when asked about more complex procedures, all the participants replied with expressions that resemble an abstract scheme of procedural knowledge such as "*improvisation*" and "*mix-and-match strategy*" which are an eclectic mix of techniques and concepts. The reason for the use of such descriptions to describe procedural knowledge is perhaps because it is an internal model that is tacitly gained from past external events (Pezzulo, 2011). The abstracted procedural knowledge mentioned by the participants represents different kinds of trials taken by the participants during the progression of a design project towards completion while in sequence reducing errors.

5.2 Constituent 2: Analogical mapping for ideation

Analogical representation is widely used for ideation. When the participants mentioned concepts to be used, it is reasoned as a guide and expects the artwork to have structural similarities that relate to goals or purpose. This indicates the process of analogical mapping, which is one of the main steps of analogical thinking (Holyoak & Thagard, 1995) and accounts for much of the process in constituent 2. For instance, P1 uses this strategy by selecting *'surrealism'* and *'hippie'* to map it towards an overall psychedelic concept of his artwork which is primarily influenced by *'the Beatles'*. However, this study did not manage to gather substantial evidence that shows the direct symbolic mapping between procedural knowledge and declarative or conceptual knowledge for ideation. Often in this study, the use of procedural knowledge is utilized after ideas are produced through symbolic mappings between at least two different conceptual knowledge.

5.3 Constituent 3: Analogical mapping to conclude ideas.

Knowledge is used to conclude ideas. Again, analogical mapping is used to evaluate either a concept is plausible for further elaboration or to backtrack for improvements. For instance, P3 uses the concept of *'minimalism'* and the visual style from the app *Spotify* and narrows it to the 'current trend' and the narrative of '*cause and effect'* that provides a symbolic relevance. This reflects a study of analogical mapping of more than one concept to form a schema driven by semantic similarity (Gick & Holyoak, 1983). This shows that several concepts are mapped to produce to conform towards a single general schema. P2 on the other end evaluates using her notion of *'something different'* and *'good enough'* which shows that the ideas are concluded based on the retrieval of similar but rather surface information or superficial analogues (Trench & Minervino, 2015). The instances explained shows that multiple concepts are anchored to a few for evaluation.

6. Conclusion

The findings and discussions show that Graphic Design with the use of Computer Graphics Technology (CGT) is a complex creative process. While many types of thinking processes can be associated with Design, analogical thinking is adequate to explain how knowledge on CGT that mostly seem as procedural, and declarative concepts that are required for design projects is used. Thus, this study proposes analogical thinking as a criterion for the creative process in Graphic Design

Furthermore, by viewing designers as analogists, the criterion for nurturing creative talents is perhaps defined by the capabilities of using knowledge as analogues. Therefore, as a thought process, this study believed that analogy could be one of the aspects in specific education settings that favour design and interdisciplinary or multidisciplinary approaches such as Problem Based Learning in STEAM education (Ahmad Dasuki, 2020). This is because such approaches in Design and education fuses knowledge from various fields, and therefore reflects an analogical thinking process. Additionally, according to Zulinda et al. (2020), effective information processing ability positively correlates with scientific reasoning. And as technology brings together design with other scientific disciplines, the use

of analogical thinking as an information processing technique among teachers and educators can aid in delivering scientific knowledge in design studios and classrooms. Moreover, the innovation industry, which benefits from creative individuals, provides an attractive job prospect for designers. Thus, encouraging the use of analogical thinking and its explication in various design tasks is advantageous among students as job competitiveness is a factor in influencing competency among graduates (Marfunizah et al., 2020).

Further studies on analogical thinking can be done due to the limitations of this study. Firstly, the participants in this study are purposively selected. Therefore, future studies among expert designers or other individuals from other disciplines might yield different experiential accounts. This is because analogical thinking or creativity, in general, is not specifically an ability of designers. Secondly, other design tasks, such as game development and engineering design, requires other relevant knowledge and expertise. Studies of analogy on these disciplines might show greater depth in analogical processing. Finally, as analogy happens primarily at a symbolic level, more studies need to be done to elucidate its efficacy on various aspects of education.

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