An Analysis of Clock Design in terms of Analogical Thinking

Gizem Hediye Eren
Eskişehir Technical University, Department of Industrial Design, Eskişehir, Turkey

Merve Buldaç
Dumlupınar University, Department of Interior Architecture, Kütahya, Turkey

ABSTRACT
Clocks are designed as an object with definite boundaries to an entity with no definite physical form like time. The study is aimed to examine the sources that inspire the forms designed to create the perception of time. The method of the study is the descriptive case study, one of the qualitative research methods. An evaluation was made on the examples with the single case design approach, one of the case analysis designs. The case under consideration is analogies that inspired designers in time presentation. The selected examples were analysed within the framework of "analogies by similarity aspects", "analogies by the distance between target and source domains", and "analogies according to level of abstraction". The examples were determined among those who prioritised the unique aspects of time in the presented forms and analysed within the analogy classifications framework. In the samples, analogies based on transferring the qualities of time as an indefinite abstract entity as sources to the clock as the target are analysed. The study presents an analogical thinking framework for design fields. Focusing on these taxonomies regarding the similarity, distance and abstraction levels while brainstorming for the source domains can influence originality and effectiveness in developing incremental and radical discourses.
Keywords: Time, Analogy, Analogical thinking, Sources of inspiration in design, Clock Design

INTRODUCTION
Creativity in design includes a certain cognitive feature, such as analogical reasoning. Many studies have shown that designers use analogies from other fields to adapt them to their own design problems. Considering the way designers use analogies, it is seen that analogies are realised in various ways (structural and/or functional) and at multiple levels, from the same, similar or different fields (Bonnardel and Marmèche, 2005, p. 428). The designers' presentation of intangible assets can be evaluated within the scope of analogical thinking, which is based on the assembling similarities between different things. Time is among those intangible assets. Time is a phenomenon in which we get our first impressions of existence through change, in other words, through becoming, flow or motion. Therefore, to describe the physical form of time, which is an abstract entity, it is necessary to embody it.

The study is aimed to examine the designers' analogical thinking mechanism underlying when conveying time which is an indefinite entity such as clocks. Thiele and Treagust's (1994) classification, one of the most common classifications in the literature, was used as the analogy classifications framework. In this classification, three approaches suitable for the design field were determined. Selected clocks were analysed within the framework of:
• analogies according to target and source similarity aspects
• analogies according to target and source domains
• analogies according to abstraction level

The examples presented were determined from among the products referring to the unique aspects of the "concept of time" and analysed within the framework of analogy

classifications. The aspects which are attributed to the concept of time and the work corresponding to that aspect are;
• subjectivity of time: To-do Day Planner clock
• merging and fusing different time zones: The Jetlag Clock
• omnipresence of time: Melting Clock
• approximations, roundness, roughness over exactness when communicating time: It is About Time Clock
• evanescence of passed time: The Momentt Wall Clock

Many clock examples involved analogical thinking mechanisms; however, these source domains were somewhat unrelated to time or different fields. Clocks are inherently designed as an object with definite limits to an entity that does not have a concrete physical form such as time. The "source" is a formless being, like time itself and the "target" is the watch's dial, the hour and minute hands, and the volume and interfaces that present them. In the examples, analogy constructions based on the unique qualities of time, an indeterminate abstract entity have been analysed.

THE CONCEPT OF TIME
Time is a measurable period during which an action, process or condition exists or persists. It is a non-spatial continuum measured in terms of successive events from the past to the present and the future (URL 1). The phenomenon of time in the lives of individuals has shown itself as an essential element from the moment of birth and continues to do so. It has produced various theories with different perspectives in many fields, from physics to philosophy, psychology to sociology. In terms of the philosophy of time, Plato and Aristotle are among the first thinkers to express two different views. Plato understands time as an image or shadow of eternity. According to this understanding, time is effective in the whole realm of existence and carries it within. The universe consists of a picture of Aion in the temporal sense as an existing or ever-changing structure (Platon, 1991). Aristotle begins by questioning the perception of daily time. This concern starts with a question of whether time belongs to existence or non-existence; in other words, the essence of time. Accordingly, time either does not exist or is a slippery and intangible thing (Aristotle, 1996, p.11). Heidegger, one of the leading names of existential philosophy, emphasizes subjectivity by mentioning that the determinant of time in physics is measurement quality (Heidegger, 1996, p. 65). On the other hand, Kant states that time is not something gained from the objective world and that it is the primary condition for man's perception of the objective world. Therefore, time is subjective and ideal, does not consist of simple parts, and there is a compositeness as the basis of continuity in time (Toprakkaya, 2007, p. 35-37). The French philosopher Bergson argues that time is something that moves from one point to another, uninterrupted, alive and non-repeating. According to Bergson, who put forward the understanding of two durations, one of these periods is; the duration obtained entirely by intuition within the individual; the second one is defined as the reflection of the outside world, that is, the time in which the idea of space is inserted (Sofuoğlu, 2004, p. 106).

The concept of time is handled in two ways, absolute and relative. In his absolute time view, Newton states that absolute and universal time is mathematical and that its essence flows systematically without being dependent on an external element. In addition, individuals add to their discourse that they feel the flow of time differently depending on their spiritual state, but that time is always the same (Davies, 2003, p. 17).

The theory that states that time flows at different points in the universe at different speeds or even stops; and is not an absolute concept, but a variable perception, is the Theory of Relativity, laid by Einstein in 1915. It is a kind of perception that is extremely difficult to describe, felt by our senses as a result of a series of events. The time comes in three modalities in mythology:
- "**Chronos** (chronic time/Saturn) is quantitative, homogeneous, secular time. Chronic time is a mere conventional measurement, a means of counting time to be

able to use it as we see fit for our personal economic or public political ends, as something to be "spent" or "wasted". It is time, as materialistic physical science knows it.

- **Kairos** (kaironic time/Uranus) is qualitative, heterogeneous, seasonal, archetypally informed time. Kairos reveals that there are certain times when the order of things, the cosmos, the would-soul, attempts to persuade human souls to participate in the unfolding of events in a particular way. Kairos allows for a "subject-situation correlation." Kaironic time introduces novelty into the banality of linear, chronic time. It is time as "creative advance" to use. It is timeliness.
- **Aion** (aionic time/Neptune) is unbounded, sacred or eternal time. Aion is time as a moving image of eternity, an infinite circle, and a sphere whose centre is everywhere and whose circumference is nowhere" (Segall, 2015).

The flow of time is understood by comparing the observed motion changes in the environment. All events experienced within the framework of cause-effect relationships and all activities observed around give the impression that time has passed. The concepts used to measure time vary widely, and time perception can flow at different speeds for individuals. The factor that provides an idea about the flow of time is the references used for time. Time is a perception that one cannot make a firm judgment about how fast it flows without specific references. The important thing is that these references are not immutable and fixed. The General Theory of Relativity showed that space has different time zones according to velocity and position. According to this theory, time is not absolute and immutable (URL 2).

ANALOGICAL THINKING

An analogy is a comparison of two otherwise unlike things based on the resemblance of a particular aspect; or similarity in some particulars between things otherwise unlike (URL 3). Analogical thinking is used today for comparisons and simulations in different fields, including design.

While Glynn (2007, p. 53) explains analogy as "conceptual bridges established between source and target", Mayo (2008, p. 14) defines it as "an explanatory tool established between the old and the new". On the other hand, Castillo (1998, p. 38) defines analogy as "creative and powerful tools for assimilating new information and adapting it to existing basic knowledge". To solve an unfamiliar problem, it is common practice to use similar features of the solution of a familiar problem. An analogy can be thought of as an explanation of how people approach unknown situations to reach conclusions and solutions (Castillo, 1998, p. 39). Küçükturan (2003, p. 10) defines analogy as "explaining an unknown, unfamiliar phenomenon with known and similar facts"; the known case is the source; the unknown is the target. When applying analogy, it is essential to clarify how and for what purpose the similarities are established in comparing the known and the unknown. Gentner (1989, p. 231) defined analogy as "a tool that shows that two units are related in terms of proximity structure, although they contain different objects". According to Itkonen (2005, p. 17), an analogy is a structural similarity, and all concrete or abstract elements can be explained with analogies. The most common analogies are; is the part-whole relationship and the relationship between the parts of a system.

Most cognitive psychology researchers concur that creativity involves creatively rearranging components from preexisting knowledge bases to generate a new concept (Gagne and Shoben 1997, p. 84; Hampton 1997, p. 907; Ward 1994, p. 38). It has been suggested that analogical thinking serves as the fundamental process behind creative work, allowing individuals to transfer knowledge from well-known, preexisting categories (source domains) and utilise it to build their own ideas (the target domain) (Gentner and Markman 1997, p. 52).

The designers' creativity can partially be explained by analogical thinking. Schematically, to solve the "target" problem, the designers would refer to a similar problem or situation

for which a solution already exists, and they would transfer certain features of this source solution to develop a target" solution for the problem they deal with (Bonnardel, 2000, p. 506). Practitioners in new product development recognise the importance of analogical thinking and actively encourage using multiple analogies in generating new product designs (Goel, 1997, p. 68). For example, IDEO, a product design consulting firm, designed products incorporating technological solutions from outside industries during idea generation. A desk lamp uses articulating ball-and-socket joint design taken from principles in human hip-bone sockets (Hargadon and Sutton, 1997, p. 724). Other practitioners also promote the use of multiple analogies during creative tasks and encourage the use of both functional and structural analogies (Dahl and Moreau, 2004, p. 48).

Analogical thinking is common at the early phases of the design process where the development of concepts and ideas occur (Goldschmidt and Smolkov, 2006, p. 567). The investigation of external stimuli, such as convenient inspiration sources that can function as analogous sources since they can help with idea generation, makes up a substantial proportion of the design process (Cardoso and Badke-Schaub, 2011, p. 144). Identification of cues from outside sources facilitates communication with internal representations and impacts idea generation (Goldschmidt, 1995, p. 56).

Drawing analogies is an approach that can open up or restrict the "research field" of new ideas, depending on the nature of the resources called upon to solve the problem at hand. Analogies can be encountered at different levels according to the conceptual areas of the resources evoked in the design and the functional, aesthetic or structural qualities of the resources considered (Bonnardel and Marmèche, 2004, p. 32). However, analogical thinking has a significant role in making sense of the abstract and concretising abstract concepts in a way that the five senses can perceive. Thanks to analogies, abstract concepts that are difficult to understand can become simple and easy to understand (Soncu, 2018, p. 210).

Analogies are subject to varying classifications according to their characteristics. The Analogy Classification Framework, prepared by Thiele and Treagust (1994, p. 64) for classifying analogies in chemistry textbooks, is a suitable mechanism for organising analogies to analyse them systematically. The Framework comprises nine criteria, the first six of which (c-h) were initially presented by Curtis and Reigeluth (1984, p. 104):
a) the content of the target concept;
b) the stage of presentation of the analogy;
c) the analogical relationship between analog and target: whether the source and target share structural or functional attributes;
d) the presentation of the analogy: verbal or pictorial-verbal;
e) the level of abstraction
f) the position (before or after) of the source relevant to the target
g) the level of enrichment of the mapping
h) the pre-topic orientation to analogical nature
i) the presence of declaration regarding possible attribute mismatches

Three of these nine criteria were chosen when the design field was considered. The criteria in terms of how the analogy is used in design practices are "(c) the analogical relationship between the source and the target (similarity aspects)", "(e) the level of abstraction", and "(g) the level of enrichment of the mapping (distance between target and source domains". The designers can rely on different levels of similarity aspects, enrichment of the mapping and level of abstraction due to their experience. For instance, the type of analogies used by experts who relied on schema-driven analogies significantly differed from those used by novices who tended to use more case-driven analogies. Experts generated general design solutions from several examples, while novices used analogies where a specific concrete example was used to develop a new solution (Ball et al., 2004, p. 505). Experts more easily focus on the critical features of a problem, while novices had more difficulty retrieving

relevant information and mapping concepts from different domains (Kolodner, 1997, p. 59; Hey et et et al., 2008, p. 286).

Analogies by Similarity Aspects
The relationship between the target and the source concept is divided into three categories: Structural, functional and structural-functional analogies (Çetinkaya and Özdemir, 2018, p. 30).

● Structural Analogy (Appearance Similarity)
It is an analogy established when there is a similarity between the target's structure, appearance and physical characteristics and the source (Erol Şahin, 2014, p. 51). If we explain structural analogy with a product design, Volkswagen Beetle can be given as an example. Here, the target is the VW Beetle, and the source is the bug it resembles. The people respected the unique moniker of the automobile. The car's subsequent, bug-like nickname resulted from its curves and rounded top, which was initially named Volkswagen Type 1. In the late 1960s, Volkswagen began referring to the vehicle as the VW Beetle, indicating that they must have known they had a winner on their hands (URL 4).

Figure 1. VW Beetle (Volkswagen Type 1) (URL 5)

● Functional Analogy (Relational Similarity)
They are analogies in which the similarity between the target and the source is not physical but based on the working principle (Erol Şahin, 2014, p. 50). If we explain functional analogy with a product design, a gecko-inspired soft, passive gripper can be given as an example. Here, the target is the passive gripper, and the source is the gecko's hand. Six soft bending actuators make up a soft, passive gripper that is grouped in the form of a star. The actuators are positioned to bend upward to minimise first contact with the item. A commercial tape with mushroom-shaped adhesive features is put to the bottom regions of the actuators to promote attachment. After applying pressure, the bending actuators separate from the item, releasing it. The concept was influenced by the way gecko feet tear off surfaces because they have such strong stickiness (Siebel et al., 2020, p. 1).
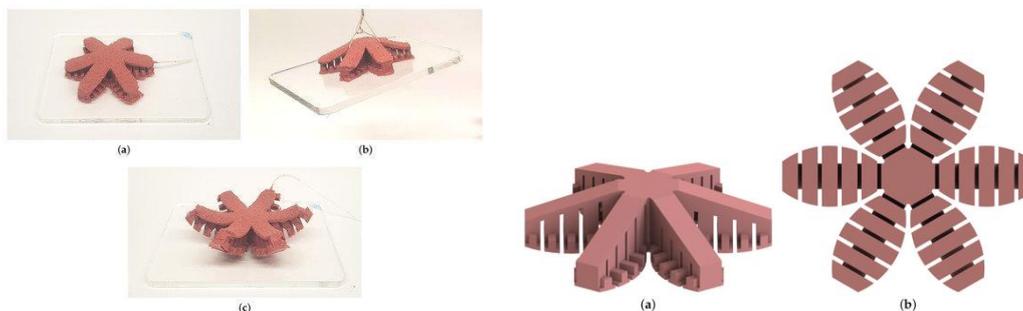
Figures 2 and 3. A gecko-inspired soft passive gripper
Source of Images 2 and 3: (Siebel et al., 2020, p. 7-8)

● Structural-Functional Analogy (Full Similarity)
It is an analogy established when there is a similarity between the source and the target, both physically and in principle. Making various simple tools by taking the wings of birds, the fins of fish, the characteristics of different plants and their working principles as examples can be given as examples of these analogies (Erol Şahin, 2014, p. 50). If we explain structural-functional analogy with a sample of product design, soil digging gloves can be given as an example. Here, the target is a wearable gadget that will enable digging the earth, and the similarity is the structures of a cat's claws. In this analogy, the gloves that allow people to dig faster are the target, and the claw is the source.
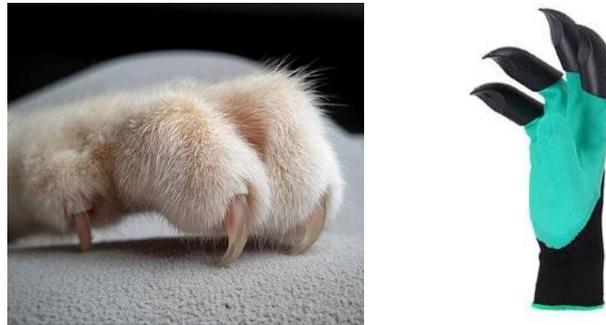
Figures 4 and 5. A cat's claws and earth-digging mitt (URL 6; URL 7)

Analogies by the Distance between Target and Source Domains
It is related to the subject on which the target concept in the analogy is generated and divided into two categories (Çetinkaya and Özdemir, 2018, p. 30).

● Intra-domain analogy (Same field)
They are analogies in which the target and the source are selected from the same field (Erol Şahin, 2014, p. 54). In-field analogies express the same semantic field as the object to be designed. The evoked inspirations share many semantic properties with the target object. Thus, the invoked things and the target object belong to the same category.
For example, if the target object is a cyber cafe chair, then connections with an office chair or a camp chair can be established (Bonnardel and Marmèche, 2005, p. 423). Variations within the armchair antecedent or generic group regarding secondary functions are examples of such analogies.

● Inter-domain analogy (Different fields)
These are analogies where the target and source are in different fields (Kesercioğlu et al., 2004, p. 37)—giving concrete examples while explaining an abstract subject falls into this analogy class. The aim is to use a concept from any field that users can easily visualise as a source in explaining a target concept from a different domain (Erol Şahin, 2014, p. 55). Intra-domain analogies arise from real conceptual leaps from the category of the object to be designed. These analogies are based on attributes or properties of the target object, which are neither antecedent nor generic as they are not prototypes of the category, for example, the softness or warmth of a seat. Such features can be used as cues to activate long-term memory inspirations far away from the target object: a nest or a wave. These cross-domain analogies appear to be, on a linguistic basis, the most inventive and allow the expansion of the search space that was initially considered (Bonnardel and Marmèche, 2005, p. 425).

If we explain it with a product design example, the Bottle Bank Arcade game, which is awarded by The Fun Theory, which states that the easiest way for people to change behaviour is through entertainment, would be a good representation of the subject. The goal is to encourage people to segregate packaging waste in a bin. The analogy is a bottle bin converted into an arcade game with lights and a scoreboard, and whenever people put a bottle into the bank, they score points. In other words, while the target is the bottle bank, the source is the arcade game. The Bottle Bank Arcade machine collects used glass

bottles for recycling. Six holes with blinking lights and a display panel recording the scores are the engaging elements to invite people not only deposit bottles but also to play a retro arcade game. The Bottle Bank Arcade machine is designed to encourage more people to recycle bottles by making it fun (Kim, 2015, p.10).

Figure 6. Bottle Bank Arcade game awarded by The Fun Theory (URL 8)

Analogies by the Level of Abstraction
"Concrete" entities are those that the senses can perceive, and "abstract" ones are those that cannot. This approach divides analogical thinking mechanisms into three according to the abstractness and concreteness of the target and source concepts: concrete-abstract analogies, abstract-abstract analogies and concrete-concrete analogies (Çetinkaya and Özdemir, 2018, p. 30). While establishing similarity according to the level of abstraction, the first concept stated is the source concept, and the second concept refers to the target (Demirci Güler, 2007, pp. 30-31).

● A concrete-concrete analogy will be established if a concrete target concept is explained with a concrete source (Çetinkaya and Özdemir, 2018, p. 30).
● An abstract-abstract analogy will be established if a concrete source is used to explain the abstract target concept
● An abstract-abstract analogy will be established if abstract goals are likened to abstract concepts (Çetinkaya and Özdemir, 2018, p. 30).

As seen in the examples above, analogies are mapped from different sources to their destinations differently. As a result of analogical thinking, first, analogies are constructed, and common sense verifies the validity of these relations. Then, by ensuring the intelligibility of the analogy, a predictable mapping that will create a universal meaning is constructed. Finally, the transfer of the determined qualities from the source to the target is established.

Time is divided into units and presented by clocks and calendars and, as we perceive it, is a product of analogy. Although the clocks that present time to people in physical form are inherently a product of analogy, it is possible to feed this analogy with richer analogies within the framework of concretisation. Time-specific qualities are transferred to the clocks by an analogy between the markers of time and the medium that presents it. In this study, the analogies established by the designers for time will be analysed through examples based on similarity aspects, domain distance, and abstraction levels.

METHOD
The method of the study is the descriptive case model, one of the qualitative research methods. An evaluation is made on the examples with the single case design approach, one of the case study designs. In the nested single-case pattern, there is often more than one sub-layer or unit in a single case in which there is more than one analysis unit, and there is a tendency for more than one sub-unit that may be in a case (Yıldırım and Şimşek, 2008, p. 292). The case discussed here is the inspiration and analogy constructions of the designers in the presentation of time.

Analogies that deal with the unique aspects of the concept of time, which is considered as the case of this study, will be analysed through the design of (1)To-do Day Planner Clock, (2) The Jetlag Clock, (3) Melting Clock, (4) It is About Time clock, (5) The Momentt Clock (Table 1).

Limitations in Sample Selection
The samples examined within the scope of the study consist of design sites in online daily life, such as Designboom, Design Milk, Yanko Design, Dexigner, Artsy, and products with the #clockdesign hashtag on Instagram (on the date of the Instagram query -20 April 2022- with this hashtag 58200 samples were reached, and samples were determined with a quick visual scan). The use of analogies regarding inherent aspects of time was taken into account in the selection of the clocks (Table 1). Since the analogies are based on abstract-concrete analogies by their nature, two indicators related to sample selection were taken into account:
• The structural and functional attributes of the source (structural and/or functional analogy)
• The proximity of tailored sources (inter-domain analogies and intra-domain analogies)

Table 1. Cases and sub-units handled with a nested single-case design

Case	The designers' analogy construction for presenting time
sub-unit -1	To-do Day Planner Clock
sub-unit -2	The Jetlag Clock
sub-unit -3	Melting Clock
sub-unit -4	It is About Time Clock
sub-unit -5	The Momentt Clock

DISCUSSION
Sample-1: TOO-Do Day Planner Clock (Too Designs)
This clock enriches family communication and makes it easier to spend life at home. For example, if a family member writes down the day's schedule on the whiteboard dial, the family can grasp the day's program at a glance without disturbing the working people (URL 9).

Figure 7. TOO-Do Day Planner Clock (Too Designs) (URL 9)

When the analogical approach of this product design example is considered, the target is the *clock's dial* while the source is a *whiteboard*. It customises time to make sense in a personal context by subjectively referring to the rationality of time. Here, it is constructed with a whiteboard analogy that allows personalisation. This rewritable clock can be organised as a to-do list, a schedule or a clock with personalised artwork. The analogy between the source *whiteboard* and the target *clock's dial* is based on the "structural-functional analogies", which is the analogy established when there is a similarity between

the source and the target both physically and in principle. The dial represents a 12-hour time zone that acts as a schedule/ day planner divided into specific periods. It is designed to create time slots from the whiteboard both visually and functionally divide time into segments. It is based on "inter-domain analogies", an analogy in which the target and the source are selected from different fields; because here, the dial and the whiteboard are objects belonging to different domains. The level of abstraction is based on "abstract-concrete analogies", where time as an abstract concept is embodied through a concrete whiteboard.

The Jetlag Clock (Alberto Ghirardello)
The Jetlag Clock combines two dials to show the time in two separate locations by the shape of a fusion of two dials, and hours are marked by a series of holes which merge and become common to both pairs of hands. As a time-zone wall clock, it lets users modify and rearrange the hours and countries displayed on each dial and write in the name of home and new lands (URL 10).

Figure 8. The Jetlag Clock (Alberto Ghirardello) (URL 10)

In the analogical approach of this clock design, the target is the *clock's dial*, and the source is a *fusion*. The analogous relationship between the source, which is fusion and the target, which is the clock's dial, is based on "structural analogies", an analogy established when there is a physical similarity between the source and the target. The fusion of two dials combines two clocks to show the two time zones on a single display simultaneously. It is based on "inter-domain analogies", an analogy in which the target and source are selected from different domains. A solid dial showing circular time and the fusion of two circles are states belonging to other domains since it is impossible to combine solid objects in this way. For this reason, this feature has been transferred here from a universe belonging to different phases. The level of abstraction is based on "abstract-concrete analogies" in which the abstract concept of time is embodied through a concrete unification of different time zones on a single display.

Melting Clock (Salvador Dali)
Melting clocks are a recurring image in Salvador Dali's surrealist classic The Persistence of Memory (1931). The surreal painting, on permanent exhibit at the Museum of Modern Art in New York, depicts the loose clocks laid across furniture, trees, and even a sleeping person's face. These melting clocks, sometimes known as soft or drooping timepieces, recurred throughout Dali's career, leading to various interpretations. Some academics relate this emblem to time's control over people and omnipresence, while others relate this to Dali's observation of a slice of runny cheese melting in the sun. These signs stand for the concept of time, consuming everything and itself. Today, there are examples designed to be used as desk clocks in a commercial sense.

Figures 9 and 10. "Profile of Time" sculpture (Salvador Dali, 1977); Melting Clock (URL 11, URL 12)

In the analogical approach of this clock design, the target is *the clock's dial*, and the source is *melting, a phase change, a transition from solid to liquid*. The analogy between the source melting and the target watch dial is based on "structural analogies", which is the analogy established when there is a physical similarity between the source and the target. The omnipresence of time and its mastery over humans is expressed with melting. It is based on "inter-domain analogies", in which the target and source are selected from different fields. Although there are solid fusible objects, this is unlikely to occur for a clock's raw materials at room temperature or under the sun. Therefore, they are states belonging to different domains. For this reason, this property has been transferred from a universe belonging to an object (such as cheese) made from different raw materials. The level of abstraction is based on "abstract-concrete analogies" in which the omnipresence of time, an abstract concept, is embodied through melting, a phase change that can be physically observed.

It's About Time clock (Laurence Willmott)
This clock is based on the idea that people round time up when communicating "rough time". It tells the time using words to provide a true reflection of how people view time.[1] This clock tells time using words rather than numbers, reflecting how people view time and those who deal in approximations. The designer is inspired by how people adapt products to suit our needs and, in some respects, re-design the products ourselves (URL 13).
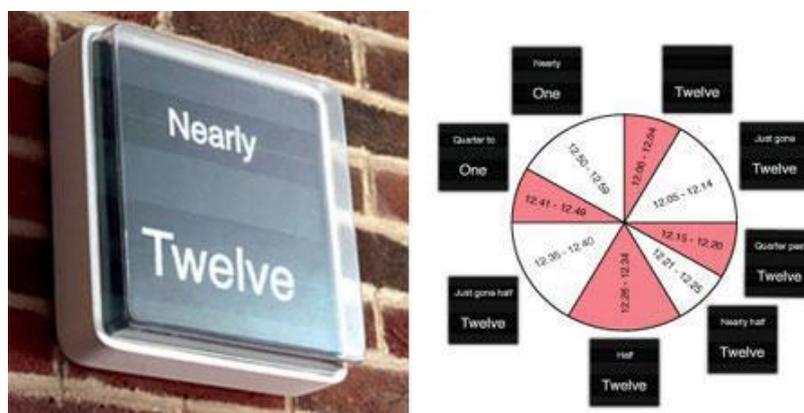

Figure 11. It's About Time clock (URL 13)

When the analogical approach of this product design example is considered, the target here is the *clock's display*, and the source is *what people naturally communicate when describing the time to each other*. This communication involving approximations, roundness, and roughness over exactness is constructed with an analogy of a display that allows one to

---

[1] https://design-milk.com/its-about-time-clock/

express time verbally. The analogical relationship between the source, which is approximations and the target, which is the clock's dial, is based on "structural-functional analogies", the analogy established when there is a similarity between the source and the target both physically and in principle. The clock formally and functionally displays the approximations that define the rough time. It visually and functionally does not represent time with precise pinpoints but makes an imperfect but convergent definition. It is based on "intra-domain analogies", the analogy in which the target and source are selected from the same field since both domains describe time with rounding instead of precise limits. The level of abstraction is based on "abstract-concrete analogies", in which time, an abstract concept, is embodied through daily verbal expressions.

The Momentt Wall Clock (Böttcher and Kayser)

The Momentt wall clock is inspired by the idea of overcoming time limits, and experiencing it more than a feeling. It comprises a funnel-shaped, matt steel housing with a diffused front glass. The time seems to blur with space, and the hands disappear into the depth of the centre of the clock. The designers aimed to focus on the moment and the presence that occurs when we forget the time and play with our diffuse and unreal perceptions (URL 14).

Figure 12. The Momentt Clock (URL 14)

When the analogical approach of this product design example is considered, the target here is the *clock's dial and hour and minute hands*, and the source is *vanishing something for experiencing it as a feeling*. Vanishing time within the space is conveyed by a display that allows fading the hour and minute hands out. The analogy between the source *fading* and the target *clock' dial* is based on "structural analogies", which are analogies established when there is a physical similarity between the source and the target. The clock's hands formally blur, vanish and disappear in space, and become evanescent to convey the messy and unreal sense of time visually. It is based on "intra-domain analogies", the analogy in which the target and the source are selected from the same field. While the source domain is *vanishing*, the target domain is *forgetting*. The level of abstraction is based on "abstract-concrete analogies", in which time, an abstract concept, is embodied through fading, a concrete visual expression.

CONCLUSION

Making analogies is a critical process that helps generate new ideas. Designers tend to adopt various perspectives on sources of inspiration and consider multiple types of sources. When the subjects that inspired the designers were evaluated, an analysis was made by focusing on the approaches that refer to the unique aspects of time. It is seen that designers use analogies from various fields extensively to adapt them to their own design problems. By using Thiele and Treagust's (1994) analogy classifications, three of them suitable for constructing analogies in the design processes were selected. In the study, the

examples were analysed through analogies according to the relationship between the source and the target in terms of similar qualities, domain distance, and abstraction levels. The samples are the clocks which display time, an entity with indefinite physical form. They are designed as interfaces for transferring certain boundaries. In the examples specified, the source is the time, and the target is the displays and interfaces, such as the dial, hour and minute hands of a clock. The meaning is transferred to these clocks by establishing analogies from an indeterminate abstract entity. The designers, while producing formal and functional design solutions for the concept of time, have been inspired by notions such as:

• subjectivity of time
• fusion of different time zones
• omnipresence of time and its mastery over humans
• approximations, roundness, and roughness over exactness
• forgetting the sense of vanishing time

The distinctive qualities of these examples, which were subject to this study, are that the analogies are based on the time's attributes as sources are mapped onto the target clocks (Table 2).

Table 2. Analogies in the clocks

To-do Day Planner Clock	
Source	Structure: Whiteboard Function: Subjectivity, personalisation
Target	The clock's dial
Mapping	Personalising the time by means of a whiteboard as a to-do list, a schedule or personalised artwork
Analogy	Structural-functional: Personalising the dial with the help of a rewritable whiteboard Inter-domain: Subjectivity of time – a whiteboard Abstract-concrete: Subjectivity of time – a whiteboard

The Jetlag Clock	
Source	Structure: Fusion
Target	The clock's dial
Mapping	The fusion of two dials combines two clocks to show the two time zones on a single display simultaneously
Analogy	Structural: Fusion, merging Inter-domain: Fusion – displaying different time zones on a single surface Abstract-concrete: Fusion of different time zones – the fusion of two circles

Melting Clock	
Source	Structure: The state of melting
Target	The clock
Mapping	the omnipresence of time and its mastery over humans is expressed by melting
Analogy	Structural: The state of melting Inter-domain: The state of melting at room temperature or under the sun – a property away from the raw materials of a clock Abstract-concrete: The omnipresence of time – melting

It is About Time Clock	
Source	Structure-Function: The clock formally and functionally displays the approximations that define the rough time
Target	The clock's display
Mapping	What people naturally communicate when describing time to each other involving approximations, roundness, and roughness over exactness is constructed with an analogy of a display that allows one to express time verbally
Analogy	Structural-functional: Communicating visually and functionally by not representing time with precise pinpoints but making an imperfect but convergent definition Intra-domain: Roughness – displaying an imperfect but convergent definition of time Abstract-concrete: Roughness in communicating time – verbal display

The Momentt Clock	
Source	Structure: Vanishing something for experiencing it as a feeling (the messy and unreal sense of time)
Target	The clock's dial and hour and minute hands

Mapping	Vanishing time within the space is conveyed by a display that allows fading the hour and minute hands out
Analogy	Structural: The clock's hands formally blur, vanish and disappear in space, and become evanescent Intra-domain: forgetting the sense of vanishing time – fading Abstract-concrete: Forgetting the sense of time – fading, a concrete visual expression

The analogies are established only structurally or both structurally and functionally, within or outside the domain between the source and the target. Through analogies, the qualities attributed to an abstract entity such as time (source) acquire a form (target): for subjectivity, a customisable whiteboard; for fusion, the merging of different time zones on the same dial; for omnipresence, melting; for roughness, an interface that verbally expresses time; for vanishing, a formal transfer with the hour and minute hands that are vaguely visible behind the dial attributed to clock designs.

The designers use analogical thinking to access and use information from multiple domains. By documenting the analogical relationships of concepts generated for clock designs, this research aimed to serve as a basis for questioning the conditions under which analogical thinking can enhance originality. The study examined the influence of the similarity aspects, distance factor, and abstraction levels of analogies to reveal the benefits of analogical thinking to concept generation. Based on the case of clock designs, the study presents an analogical thinking framework for design fields. Focusing on these taxonomies regarding the similarity, distance and abstraction levels while brainstorming for the source domains can influence originality and effectiveness in developing incremental and radical discourses.

REFERENCES

Aristoteles. (1996). Fizik. Zaman Kavramı [Physics. The Concept of Time] (S. Babür, Trans.). pp. 8-41, Ankara: İmge Yayıncılık.

Ball, L. J., Ormerod, T. C. and Morley, N. J. (2004). Spontaneous analogising in engineering design: A comparative analysis of experts and novices. *Design Studies, 25*(5), 495-508.

Bonnardel, N. (2000). Towards understanding and supporting creativity in design: analogies in a constrained cognitive environment. *Knowledge-Based Systems*, *13*(7-8), 505-513.

Bonnardel, N., & Marmèche, E. (2004). Evocation processes by novice and expert designers: Towards stimulating analogical thinking. *Creativity and Innovation Management, 13*(3), 176-186.

Bonnardel, N., and Marmèche, E. (2005). Towards supporting evocation processes in creative design: A cognitive approach. *International Journal of Human-computer Studies*, *63*(4-5), 422-435.

Castillo, L. C. (1998). The effect of analogy instruction on young children's metaphor comprehension. *Roeper Review*, *21*(1), 27-31.

Cardoso, C., and Badke-Schaub, P. (2011). The influence of different pictorial representations during idea generation. *The Journal of Creative Behavior, 45*(2), 130- 146.

Curtis, R. V. and Reigeluth, C. M. (1984). The use of analogies in written text. *Instructional Science, 13*, 99-117.

Çetinkaya, M. and Özdemir M. Ç. (2018). Matematiksel analoji geliştirme çalışması. *Bilim, Teknoloji, Mühendislik, Matematik ve Sanat (J-STEAM) Eğitimi Dergisi, 2*(1), 27- 49.

Dahl, D. W., & Moreau, P. (2002). The influence and value of analogical thinking during new product ideation. *Journal of marketing research*, *39*(1), 47-60.

Davies, P. (2003). *Bir zaman makinesi yapmak.* (A. Ergenç, Çev.) İstanbul: Gelenek Yayıncılık.

Demirci Güler, M. P. (2007). *Fen öğretiminde kullanılan analojiler, analoji kullanımının öğrenci başarısı, tutumu ve bilginin kalıcılığına etkisinin araştırılması.* Doktora Tezi, Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.

Erol Şahin, A. N. (2014). *Tariĥ Öǧretiminde Analoji Yönteminin Kullanılımasının Ortaöǧretim Öǧrencilerininı, Başarılarına ve Tariĥsel Düşünme Becerilerine Etkisi.* Yayımlanmamış Doktora Tezi. Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Ankara.

Gagne, C. and Shoben, E.J. (1997). The influence of thematic relations on the comprehension of nonpredicating combinations. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 23* (1), 71–87.

Gentner, D. (1989). The mechanisms of analogical learning. In S. Vosniadou and A. Ortony (Eds.), *Similarity and analogical reasoning* (pp. 199–241). Cambridge University Press. https://doi.org/10.1017/CBO9780511529863.011

Gentner, D., and Markman, A. B. (1997). Structure mapping in analogy and similarity. *American Psychologist, 52*(1), 45–56. https://doi.org/10.1037/0003-066X.52.1.45

Glynn, S. M. (2007). Methods and Strategies: The teaching-with-analogies model. *Science and Children*, *44*(8), 52-55.

Goldschmidt, G. (1995). Visual displays for design: Imagery, analogy and databases of visual images In A. Koutamanis, H. Timmermans, and I. Vermeulen (Eds.), *Visual databases in architecture* (pp. 53-74). Aldershot, Avebury.

Goldschmidt, G., & Smolkov, M. (2006). Variances in the impact of visual stimuli on design problem solving performance. *Design studies*, *27*(5), 549-569.

Goel, A. K. (1997). Design, analogy, and creativity. *IEEE expert*, *12*(3), 62-70.

Hampton, J. A. (1997). Conceptual combination: Conjunction and negation of natural concepts. *Memory and Cognition, 25* (6), 888–909.

Hargadon, A. and Sutton, R. I. (1997). Technology brokering and innovation in a product development firm. *Administrative science quarterly*, 716-749.

Heidegger, M. (1996). Zaman Kavramı. *Zaman kavramı*. (S. Babür, Çev.), 56-102, Ankara: İmge.

Hey, J., Linsey, J., Agogino, A. M., & Wood, K. L. (2008). Analogies and metaphors in creative design. *International Journal of Engineering Education, 24*(2), 283.

Itkonen, E. (2005). *Analogy as structure and process.* Amsterdam: John Benjamins.

Kesercioğlu, T., Yılmaz, H., Çavaş, P. H. and Çavaş, B. (2004). İlköğretim fen bilgisi öğretiminde analojilerin kullanimi: Örnek uygulamalar. *Ege Eğitim Dergisi, 5*(1). 35-44.

Kim, B. (2015). Gamification. In B. Kim (Ed.), *Understanding gamification* (pp 10-16), *ALA TechSource, 51*(2). https://doi.org/10.5860/ltr.51n2

Kolodner, J. L. (1997). Educational implications of analogy: A view from case-based reasoning. *American Psychologist, 52*(1), 57-66.

Küçükturan, G. (2003). Okul öncesi fen öğretiminde bir teknik: Analoji. *Milli Eğitim Dergisi, 157,* pp. 9-17.

Mayo, J. A. (2008). Guidelines for teaching with analogies. *For Teachers of Introductory Psychology*, *18*(1), 12-16.

Platon (1991). Timaios. *Sämtliche werke 4: timaios / kritias / minos / nomoi* (ed. 25). Rowohlt Taschenbuch, 1991.

Segall, M. D. (2015). Minding Time: Chronos, Kairos, and Aion in an Archetypal Cosmos. Retrieved 25 February, 2022 from https://footnotes2plato.com/2015/05/15/minding-time-chronos-kairos-and-aion-in-an-archetypal-cosmos/

Seibel, A., Yıldız, M., and Zorlubaş, B. (2020). A gecko-inspired soft passive gripper. *Biomimetics*, *5*(2), 12.

Sofuoğlu, H. (2004). *Düşüncenin sinematografik yapısı hareket-zaman ve görüntü.* Eskişehir: Eğitim Sağlık ve Bilimsel Araştırma Vakfı Yayınları.

Soncu, A. G. (2018). Siyasal halkla ilişkiler açısından analoji. *Online Academic Journal of Information Technology, 9*(33), 210-220.

Thiele, R. B., and Treagust, D. F. (1994). The nature and extent of analogies in secondary chemistry textbooks. *Instructional Science, 22*(1), 61-74.

Toprakkaya, A. (2007). I. Kant'ın 'aklî ve algısal dünyanın formları ve temelleri üzerine [de mundi sensebilis atque intelligibilis forma et principiis, (von der form der sinnen-

und verstandeswelt und ihren gründen)] adlı eserinde zaman kavramının analizi. Kaygı. *Bursa Uludağ Üniversitesi Fen-Edebiyat Fakültesi Felsefe Dergisi 8*. 35-41.

Ward, T. B. (1994). Structured imagination: The role of category structure in exemplar generation. *Cognitive Psychology, 27* (1), 1–40.

Yıldırım, A. and Şimşek, H. (2008). *Sosyal bilimlerde nitel araştırma yöntemleri.* Ankara: Seçkin Yayınevi.

URL 1: Merriam Webster Dictionary (n.d.). Definition of Time, (https://www.merriam-webster.com/dictionary/time)

URL 2: Bilimfili. (14 November 2015). Einstein'ın Genel Görelilik Kuramı ve Bilinmesi Gereken 12 Madde, (https://bilimfili.com/einsteinin-genel-gorelilik-kurami-ve-bilinmesi-gereken-12-madde)

URL 3: Merriam Webster Dictionary (n.d.). Definition of Analogy, (https://www.merriam-webster.com/dictionary/analogy).

URL 4: Conradt S. (16 March 2018). 10 Not-So-Small Facts About the Volkswagen Beetle, (https://www.mentalfloss.com/article/19218/10-not-so-small-facts-about-volkswagen-beetle

URL 5: Eisenstein P. A. (14 September 2018). Volkswagen squashes the Beetle: End of the line for the iconic 'Bug', (https://www.nbcnews.com/business/autos/volkswagen-squashes-beetle-end-line-iconic-bug-n909591)

URL 6: Copson K. (27 July 2022). How to Keep Cat Claws Dull – Top Tips for Maintaining Your Cats Nails. Hepper Blog, (https://www.hepper.com/how-to-keep-cat-claws-dull/)

URL 7: ManoMano, (n.d.). Garden earth digging gloves, garden planting protective gloves, with 8 claws, (https://www.manomano.co.uk/p/garden-earth-digging-gloves-garden-planting-protective-gloves-with-8-claws-28062308?model_id=28043197)

URL 8: The Fun Theory (n.d.). Bootle Bank Arcade, (https://shoptr.education-next.com/category?name=bottle%20bank%20arcade)

URL 9: Howell, D. (30 October 2020). 5 Modern Clocks for the Time Change, (https://design-milk.com/five-modern-clocks-for-the-time-change/)

URL 10: Designboom (n.d.). Jetlag wall clock is a single dial watch that is laser-carved but has two distinct mechanisms, (https://www.designboom.com/shop/design/jetlag-cyrcus-03-22-2022/)

URL 11: Artsy, (n.d.). Melting Clocks, (https://www.artsy.net/artist-series/salvador-dali-melting-clocks)

URL 12: Etsy, (n.d.). Dali Clock, (https://www.etsy.com/market/dali_clock)

URL 13: Derringer, J., (9 April 2008). It's About Time Clock, design milk, (https://design-milk.com/its-about-time-clock/)

URL 14: Gejst, (n.d.). Momentt, (https://gejst.com/collections/momentt)