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Exploring the Elements of Bricolage as Creative Product

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ABSTRACT

Product, a critical component of creativity, was explored within a creative setting by concentrating on bricolage as deemed an implicit components of creativity. This study's major objective is to represent elements of bricolage as product creativity in a design studio. This study's primary objective is not to increase the efficacy of product creativity, but rather to accurately make a new description of the elements of product creativity based on the notions of bricolage. An experiment was performed with 25 student works designed as part of the assignment titled `inform/perform` in the basic design studio. Rating scales were utilized as evaluation instruments. Considering product creativity as bricolage, it was found that there is a statistically significant relation between design elements, design principles, and material utilization. Moreover, compared to design principles, design elements have a higher ratio of creative levels in student works.

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I. Introduction

Bricolage is a creative activity of constructing anything using whatever materials are available. It is an "other" form of mind, based in the tangible objects of the world and inseparable from material creation. As a process of creation using whatever is available, it becomes subject to the material world and tangible reality. (Real, 2008) .Bricolage, which facilitates the production of instant, intuitive, and reflecting, establishes a common ground through its identification with creative design knowledge. Bricolage that happens in a particular context tends to be one specific kind of product creativity. Although product creativity is recognized as a key component that leads to innovation, such as the development of a new product, bricolage is viewed as the possibility to generate new and inventive connections within a constrained and finite set-based activity. (Vallgarda and Fernaeus, 2015).

This study's major objective is to represent elements of product creativity from the standpoint of bricolage in a basic design studio. This study's primary objective is not to increase the efficacy of product creativity, but rather to accurately make a new description of the elements of product creativity based on the notions of bricolage. The purpose is to develop and verify an approach to address the contribution of the concept of bricolage to product creativity. An assessment for measuring product creativity may also be used to assess the link between creativity and bricolage in the design studio. To achieve a comprehensive approach, a conceptual model of bricolage that encompasses creativity and the product creation is developed through students' design works in the studio. The major purpose of evaluating product creativity was to discover the relationships and correlations between bricolage-derived characteristics of creativity.

The research starts with a description of the framework, which includes the definition, dimensions, and conceptual model of bricolage. Several students' design works for "inform/perform `as one of the studio assignments in the basic design course, were evaluated. The sample consisted of first-year design students participating in Basic Design Studio at Eskisehir Osmangazi University, Department of Architecture. Out of a total of 50 participants, 25 were chosen at random. A random sample was employed to choose the participants since volunteers were more likely to complete the assignment. This may have altered the study's findings; thus, random sampling was used instead.

1.1 Bricolage

Claude Levi-Strauss (1962) first proposed the notion of bricolage in his book "La Pensee Sauvage" (The Savage Mind), drawing an analogy between mythical perception and the reconstruction of cultural artifacts. (Kincheloe, 2005). Levi-Strauss (1994) defined the bricoleur's action as "dispersing and reorganizing clusters of occurrences (on a spiritual, social-historical, or technical level) and employing them as indestructible fragments to create structural arrangements that successively replace means and ends." Using the example of the bricoleur, Lévi-Strauss demonstrates a paradigm of interaction with diverse items, including the remnants of life events, in which each thing is interrogated to see what it could "signify" and contribute to the project at hand. William Seitz expanded on this metaphor by stressing that all pieces in the show "The Art of Assemblage" should not only mix two distinct material things but also be "discarded or stolen... rather than new." (Kini-Singh, 2023).

Bricolage is an approach that expresses the renewal, articulation, and change of human social and cultural structure and thought over time, from prehistoric man to contemporary man, to produce new structures (Levi-Strauss, 1994). This illustrates the eclectic, open-ended, fluid, flexible, variable, mutable, alterable, developable, and inventive nature of social humans. Bricolage is also regarded as significant in practice, as it corresponds to conscious or

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unconscious behaviors in daily life as well as in theory. There are two justifications for bricolage: first, epistemologically, the metaphor for the activity of the mythological mind, and second, ideologically, the distinction between conventional and modern scientific thinking and acting (Levi-Strauss, 1994; Johnson, 2012). In light of these two instances, it is crucial that metaphor not only enriches as a tool for thought but also delivers advantages as a tool for activity. The activity of bricolage employs the uncertainties discovered during the process as a working tool rather than fixing them. It has the potential to develop new and innovative connections in a limited and finite set-based activity (Vallgarda and Fernaeus, 2015)

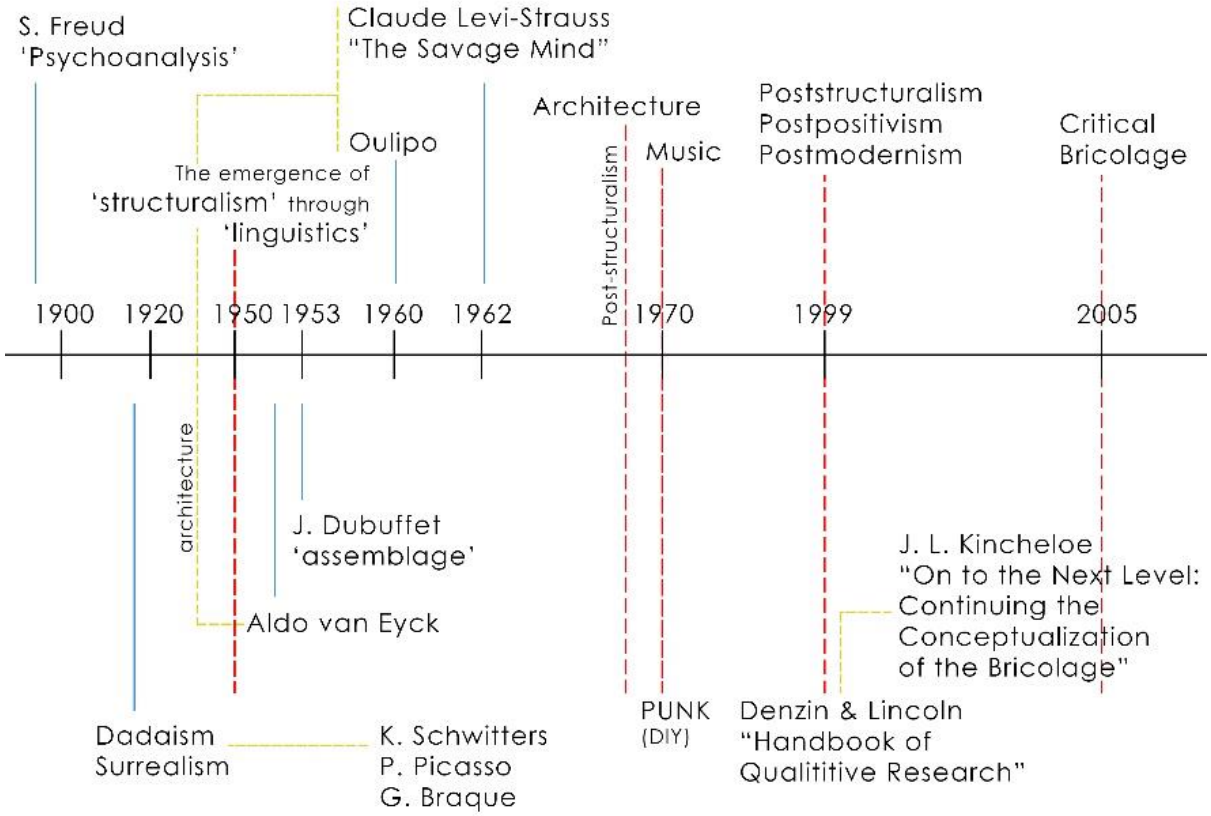

Figure 1. Subject areas of bricolage throughout the history(Karabıyık, 2022)

The bricolage gained popularity at the beginning of the twentieth century, when resources were sparse, and elements of surrealism, dada, and cubism shared a bricolage quality. Yet it wasn't until the early 1960s when the Italian movement arte povera was founded, that bricolage took on a political dimension and was used by artists to circumvent the commercialism of the art world. Arte povera artists created sculptures from the trash to devalue the art object and highlight the worth of the ordinary and every day. (Tate Art Terms, 2023). Bricolage can be seen in Sigmund Freud's psychoanalysis, in Dadaism and Surrealism's criticism of modern art, in the Oulipo movement in literature (Karabıyık, 2022)(see figure 1). Components of cubism, Dadaism, surrealism, collage, and conceptual art have a bricolage quality, both in terms of the 'do-it-yourself' nature of the works and the regard its creators devoted to readily accessible common things (Kini-Singh, 2023). With the enhancement of common and familiar material things, artists of the twentieth century embraced a bricolage model to create open systems in which new relationships between art and the daily might be defined, requiring the spectator or viewer to take an active role (Kini-Singh, 2023).

Before the 1970s, the concept of bricolage in architecture grew within the framework of principles such as democracy, freedom, and complexity. After the 1970s, it emerged with

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the postmodern ideas of holistic, eclectic, and contextualism (Scalbert, 2011) where this strategy was declared as a departure from modernism and a shift to postmodernism. According to Schnelker (2006), bricolage is not an alternative instrument in the field of architecture, but rather a concept with traces in every design. Rowe and Koetter (1978) also claimed that the concept of bricolage is met with the act of 'making' in architecture and that the mind of the bricoleur and the mind of the engineer coexist in architecture in a dialectical relationship. On the other hand, for Real (2008) the architect-artist uses bricolage as a technique to disarm the discursive machinery of contemporary building. Architecture has used bricolage as a design strategy when more appropriate materials were unavailable, via the use of repurposed materials and non-traditional architectural pieces, procedures, and equipment that were normally intended for a different purpose. Several architects and builders of the past have the mindset of a bricoleur, who, as an improviser and creator, analyses adjacent materials as dynamic, rather than lifeless, objects to generate original ideas for new projects (Kini-Singh, 2023).

Although bricolage is recognized as an alternative way of making and inventing, the word has a strong link with creativity as it signifies the repurposing of use or the utilization of readily accessible resources. Hence bricolage accepted as a method includes the creation of things using tools, by drawing from and expanding upon prior knowledge gained via learning, intuition, experimentation, and interaction (Bouvier-Patron, 2021).

1.2 Bricolage and Creativity

The literature review showed that the idea of bricolage is linked to creativity both theoretically and practically. (Le Loarne, 2005; Wu, Liu, and Zhang, 2017; Klerk, 2015; Baket and Nelson, 2005; Safina, et al, .2020; Louridas, 1999; Tian et al., 2016, Bouvier-Patron, 2021, Kini-Singh, 2023). As the term bricolage entered the creative lexicon of the period, it evolved to mean the building or fabrication of an artwork from "any" available materials. (Tate Art Terms, 2023) . These concepts, along with others like montage, pastiche, and palimpsest, which all refer to the creation of new artworks from older ones, reflect the `do it yourself` and reconstructive spirit of Lévi-idea Strauss's bricolage. These non-traditional approaches to materials and meaning-making permeated a community of artists grappling with two fundamental questions: the nature of reality and the nature of painting. (Kini-Singh, 2023).

Blankenship (2020) suggests that bricolage fosters creative thought since it enables the discovery of new connections between materials that first seem unrelated. The author also implies that bricolage training increases creativity and learning as students struggle with diverse materials and ideas to develop new meanings. On the other hand, Vallgarda and Fernaeus (2015) suggest bricolage as a form of interaction design. Authors indicate that bricolage promotes design characteristics that are ideally suited to tangible and material computing processes since it is very sensitive to the instability of the actual world and suggests a non-hierarchical negotiation of forms. Louridas, (1999) identify a metaphor for the design activity: view design as bricolage. Beginning with a description of bricolage, the author discusses the link between art and design and arrives at a definition of design that allows us to demonstrate that both traditional and contemporary design are bricolage-based and require the development of creative thinking in the background.

Examining bricolage from a creativity perspective, bricolage is a model of creativity that acquires new possibilities for implementation. Amabile (1983) describes creativity as the process through which individuals collect resources, absorb them, recombine them, and finally produce something new and useful. It seems that the bricolage as a creative activity, evokes a feeling of interest in the output: its nature is unclear until the very end. Creativity

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and improvisational freedom made bricolage a perfect approach for design students to interact with the environment. The concept as Vallgarda and Fernaeus (2015) declare promotes design principles ideal for tangible and material processes that effectively recombine new and old resources will increase product creativity. This study acknowledges bricolage as a method for product creativity, which is defined as the ability to establish novel and creative connections within a limited and finite activity-based set. It encourages designers, in this case students, to think illogically about design to discover new connections between design's fundamental concepts.

1.3 The Framework of the Method

Bricolage and creativity contain common aspects, as it opens new ways of exploration to better understand the design context. Bricolage as a means to explore creativity within a time pressure and a crisis context, the acquisition of design knowledge, and creative thinking are considered together with bricolage, implies directness irrational, and intuitive phenomena, developing instant solutions with the data at hand, making use of uncertainties, improvisation, and interactive process emerge (Le Loarne, 2005). Bricolage is regarded as a crucial method for the development of design thinking since it encourages designers to evaluate various potential solutions. Bricolage implies an unforeseen difficulty that must be handled in a relatively short period. It consists of both a process and a product that are the result of unplanned problem-solving by the bricoleur. To achieve this goal, the bricoleur repurposes the items he or she has previously collected(Le Loarne, 2005). Hence, bricolage comprises an iterative and irrational problem-solving process in which many ideas and solutions may be produced, evaluated, and potentially implemented to meet design needs(Kay, 2016).

In this paper, bricolage is defined as the design process that reveals creativity as a product and the dynamics of creativity. Within the scope of the study, it was deemed appropriate to focus on bricolage in the studio as; the creative thinking process that leads to the invention of a creative product.

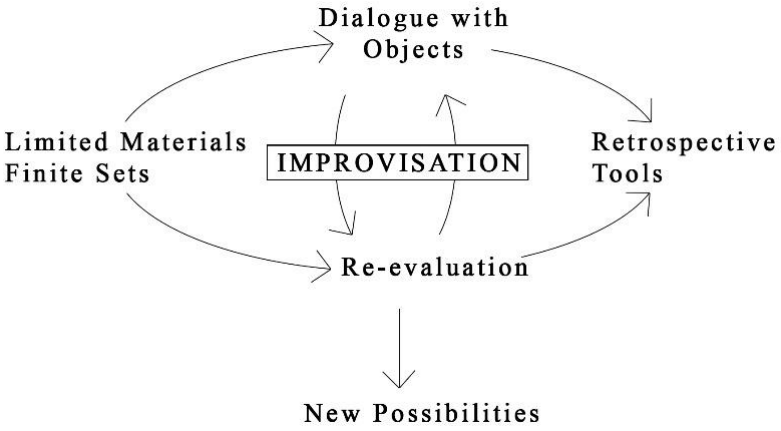

Figure 2. The studio process (Karabıyık, 2022)

In this study design studio is described as a reflective process (Figure 2). This kind of thinking approach can be recognized in Donald Schön`s (1983) reflection in action theory where he argues against logical solutions to intuitive design problems. The theory is founded on the transfer of actual, improvised, practical knowledge. This knowledge transfer is accomplished through "reflection" " movements between the activity and the practitioner. In this given circumstance, the bricoleur responds to the design situation by constructing thinking frames following the information obtained from the action-based design process.

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Bricoleur, who proceeded with this process through dialogue with objects (identifying referents in the environment) and re-evaluation with the assumption that the thinking system is fundamentally improvisational, obtains new possibilities by utilizing limited materials and finite sets, with retrospective tools. The bricoleur identifies these roles via communication with his or her inventory. The first practical step is retrospective: he/she must turn to a preexisting collection of tools and materials, conduct or re-conduct an inventory of them, and then engage in a form of conversation with them before making a selection(Louridas, 1999). This is consistent with the concept of design as a reflective dialogue with the present circumstance.

Based on this reflective process, bricolage is described as a directness, illogical, unselfconscious, irrational, and improvisational process where the purpose of bricoleur is not to examine it analytically but; to reorganize the materials to create the structure of the visualized artifact. Directness demands the use of non-original components by an unself-conscious designer. The designer adds elements to the structures he or she creates. As a result, the unconscious designer, similar to the bricoleur, attempts to create a structure from circumstances. The unselfconscious designer is a form of bricoleur. If the environment in which this bricolage occurs is steady, unselfconscious design may provide enviable outcomes. (Louridas, 1999) .

The bricoleur works with a limited assortment of diverse materials and equipment. Bricoleur will use resources even if they do not initially meet the requirements. While bricolage is an activity, the bricoleur is the actor who carries it out. As opposed to specializing in a particular area, the bricoleur employs an exploratory approach that is in conversation with things and takes complexity and multitasking into consideration. In this situation, bricoleurs enter the realm of complexity. However, bricolage may be used to indicate not just new connections between objects or concepts, but also the creation of something new via the reworking/reclassification of those objects or concepts (Le Loarne, 2005). As Vallgarda and Fernaeus (2015), pointed out, one of the essential characteristics of a bricoleur is the ability to utilize and appreciate the available materials. Materials from the past, present, and future. On the other hand, for the bricoleur, the material scale is limited, and tools that have gathered over time and have utility are repurposed. It examines, investigates, evaluates, and interprets the varied materials and tools available to it and must work within a limited set of possibilities. Consequently, a bricoleur's goal can change impromptu according to the values and reevaluation of the materials (Johnson, 2012; Levi-Strauss, 1994; Rogers, 2012). Therefore, the bricoleur's design product, design process, strategy, and outcomes are holistic. The bricoleur will interrogate, use, take stock, and interrogate again(Louridas, 1999: 519).

We interpreted the elements of the creative product as bricolage within three contents; design principles, design elements, and material utilization. As part of the elements of creativity as bricolage, design principles are discussed in a variety of design notions. Based on relevant literature directness, illogical, unselfconscious, irrational, improvisation, interactive properties of bricolage, and also observations in the studio process guided us to determine the principles of design works within sixteen concepts: *Diversity, irregularity, Randomness, transformative, interpenetrative, unity, fluidity, contrast, dynamic, articulation, overlap, Juxtaposition, adaptation, irrational, interactive and improvisational*. (see table 1) . Diversity refers to the condition of having or being composed of differing elements. Irregularity encourages leaving something unexplained in the design, evoking investigation, openness, change, and a shift in viewpoint(Pierre, 2019). Randomness refers to components that seem to lack a discernible pattern or sequence. Bricolage is discussed as a potentially transformative approach (Phillimore et al.,2016) Transformative denotes creating a substantial alteration in

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a designed object. Interpenetrative is about transforming the form as a particular adaptation or version of the design work as the process of spreading completely through something or from one thing to another in each direction. Unity is viewed as a combination or arrangement of pieces in an artistic work that makes a whole or promotes a unified overall impact. Fluidity implies the design work's physical attribute that permits it to flow. Contrast refers to the arrangement of opposite elements and effects. Dynamic is characterized by continual, constructive activity or change in design work. Articulation is the condition of being joined or linked and considered as a method of styling the joints in the formal elements. Overlapping is categorized as putting things on top of each other to give the impression of depth. Juxtaposition is the act or occurrence of comparing two or more items, often to compare or contrast or to produce an intriguing effect. Adaptation is about modification of the design work or its parts that makes it more fit for existence under the conditions of its setting. Irrational means lacking usual mental clarity or coherence; having a quantity other than that required by the metrical manner. Irrational beyond the conventional design thinking approach, students bring different materials together with distinctive spatial organization. Interactive is about creating engaging web interfaces with logical thoughts and actions that are mutually or reciprocally active. Improvisational is to make, invent, or arrange offhand. The function of improvisation in design thinking is fundamental to creative processes comprised of thinking and feeling, action and creating in complicated contexts in which designer-makers link or disconnect stages and moments while thinking and feeling their way through in several directions (Sarantou, 2018)

To assess the product creativity, elements of design are also taken into consideration. The elements of design in this study are assessed through generally recognized concepts like scale, shape, form, space, and texture (see Table 1). This taxonomy is driven by the 3-dimensional aspects of design works. Scale refers to the relative size of one piece compared to another element in a design. The shape is the external form, the edges, or the outline of the design work and the form is the three-dimensional design work that encloses the space. Form refers to the three-dimensional shape of an object, while space refers to the area or volume around, within, and between objects. Texture refers to the surface characteristics of a shape, such as how rough, smooth, or weathered it is.

One of the crucial parts of a bricolage, materials are also considered as the other dimension of a creative product. Diversified, limited, and dialogue with objects (identifying referents in the environment) are described as the properties of the materials. In bricolage, where students are instructed to collect materials from their surroundings, it is essential to utilize diversified materials. The process of bricolage often involves gathering materials from diverse sources which can result in a mix of textures, colors, and shapes. To achieve a coherent design, the usage of materials must reference one another.

Table 1. Elements of bricolage as a creative product

BRICLOAGE	**CREATIVE Product**	**Design Principles**	Diversity /irregularity / Randomness/ transformative/ interpenetrative / Unity/ Fluidity /Contrast/ Dynamic /Articulation /Overlap /Juxtaposition/adaptation / Irrational/ Interactive/ Improvisational
		Design elements	Texture/ /scale/shape/form/ space
		Material	Diversified/ Limited/ Dialogue with objects

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Three main dimensions associated with the concept of bricolage have been identified, and it has been tried to determine how these parameters related and correlated to the creative levels of student works. This evaluation approach which would be an important contribution to research on the measurement of product creativity, presents new criteria for assessing creativity as bricolage.

II. Method

2.1 Participants

The sample was comprised of first-year design students enrolled in the basic design studio of the Department of Architecture at Eskisehir Osmangazi University. 25 participants were selected by randomization from a total of 50. Since volunteers may have been more motivated to finish the assignment, and this may have altered the study's findings, random sampling was used instead of a voluntary basis to choose the subjects.

2.2 Design assignment

The basic design studio is one of the most essential courses in first-year design education. The curriculum intervention of the course aims to foster students' divergent thinking abilities, and also their creativity. In the 2019-2020 spring semester of the basic design studio, one of the assignments titled `inform/perform ` was developed in the light of the concept of bricolage. The main idea here was to conduct the idea of bricolage through creating three-dimensional spaces.

Students were expected to design bricolage that was instructed as producing with commodities/objects that came together by chance, repeated, stacked, or juxtaposed. Several types of volumes were described with the pieces and a new 3d composition was created by bringing them together. Students were asked to randomly produce more than one form with the materials they already had in their hands or the studio and to mold the assemblages with the help of materials such as plaster cloth, newspaper, glue, etc. (see Figure 1). The students began by exploiting the ambiguity of the provided design problem. By employing them as instruments, the uncertainties in the bricolage were intended to be transformed into opportunities. At every stage of the assignment, students acted unpredictably and produced design items that were not initially envisioned. This improvisational procedure advanced as a result of both instructor feedback and the discovery of new goals upon reviewing the design products. They were instructed to utilize readily available on-hand supplies. Limited to the materials available to them, students were enabled to make new and creative connections within a limited and finite set.

Figure 3. Some student works in a studio

As a result, the assignment required the reuse and exploration of the potential of all materials found randomly in the studio or immediate surroundings through the synthesis of new possibilities with limited materials, and the attainment of randomness, eclecticism, and open-mindedness through an improvisational process. We did not anticipate the final

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products to be particularly robust; rather, we valued harmonious cooperation, experimental activities, and inventive solutions.

2.3 Scoring

The scoring approach was done on a five-point scale (poor, poor-average, average, average-excellent, excellent) as the product characteristics necessitate a more detailed categorization(Hasirci & Demirkan, 2017). This rating scale is utilized through the idea that product creativity cannot be defined and only occurs if qualified judges agree that it does (Amabile ,1983). So, three raters, including one of the instructors of the studio and the authors also the instructors of the studio, evaluated each student's work separately; hence, the potential of influencing one another during the grading process was avoided. The raters were trained to score the products group and self-training sessions.

To achieve consistency among rater judgments and reduce measurement errors, sample studio works that were not included in the evaluation were used for training. After the training was completed, each of the three raters independently scored the products. The final product`s score was determined by calculating the raw averages of the three scores, and an inter-rater reliability test was conducted to compare the instructor's and observer's ratings of the product. Overall, no major differences were seen across the evaluations.

4.4 Rating Scales

The assessment comprises individual evaluations of the elements of creative product components. The instructors defined each aspect under these headings to guarantee their understanding of it. The evaluation of the product was based on the following criteria:
Elements of bricolage as the creative product :
Design principles: Diversity/irregularity/Randomness/transformative/interpenetrative/ Unity/Fluidity/Contrast/Dynamic /Articulation/Overlap/Juxtaposition/adaptation / Irrational/ Interactive/ Improvisational
Design elements: Texture/scale/shape/form/ space/
Material utilization: Diversified/ Limited/ Dialogue with objects

III. RESULTS AND DISCUSSION

3.1 Inter-Rater Reliability

All student works in studio assignments were evaluated by three raters, and the student score for each item was determined by averaging the raters' evaluations. Before calculating the mean student scores, inter-rater reliability was examined. Each student`s works for design principles, design elements, and material utilization are the total of all points for each response.

The total item scores for the design principles, design elements, and material utilization were not analyzed for inter-rater reliability; rather, rater judgments on each work were taken into account, as the response-based approach allowed for a more precise examination of the consistency of rater judgments. Inter-rater reliability (IRR) was analyzed via (a) Interclass Correlation Coefficient (ICC) and (b) Fleiss' Kappa. Inter-rater reliability results are presented in Table 2. Overall, the ICC and Fleiss' Kappa (κ) analyses revealed fair to excellent agreement between the three rater judgments.

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Table 2. Interrater reliability results for studio assignment

Product Creativity			Design Elements			Material Utilization		
ICC[a]	Fleiss' Kappa[b]	Agreement Classification[c] by ICC / Fleiss' Kappa	ICC[a]	Fleiss' Kappa[b]	Agreement Classification[c] by ICC / Fleiss' Kappa	ICC[a]	Fleiss' Kappa[b]	Agreement Classification[c] by ICC / Fleiss' Kappa
.996	.469	E/M	.977	.377	E/F	.974	.569	E/M

[a] The Intraclass Correlation value was calculated as a two-way random-effects model with a consistency definition. The reported value is the average measures for the three rater judgments per participant response (p<0,05).
[b] Fleiss' Kappa value was calculated for the scores of the three raters per participant response (p<0,05).
[c] Agreement Classifications for Intraclass Correlation were assigned based on Koo and Li (2016) where P is Poor (<0.50), M is Moderate (0.50 - 0.75), G is Good (0.75 - 0.90) and E is Excellent (>0.90) and for Fleiss' Kappa, the classifications were based on Landis and Koch (1977), where P is Poor (<0.00), S is Slight (0.01 - 0.20), F is Fair (0.21 - 0.40), M is Moderate (0.41 - 0.60), S is Substantial (0.61 - 0.80) and AP is Almost Perfect (0.81 - 1.00).

3.2 Overall Results

The mean scores of the elements of bricolage as a creative product; design principles, design elements, and material utilization of the design works, were calculated by taking the overall average of all related issues. The mean of the creative product was calculated by taking the average score of the design principles within sixteen factors; design elements with five factors and material utilization with three factors in the rating scales. It was assumed that the highest mean score is in material utilization and diversified asset of material utilization, respectively ($\bar{x}$ =3.80, $\bar{x}$ =4.18). Moreover, the adaptation and scale have the highest mean scores, respectively ($\bar{x}$ =2.84, $\bar{x}$ =3.29) (see Table 3). The mean scores of the design principles, design elements, and material utilization of the design works were calculated for each student's work, one by one, taking the overall average of all the elements of bricolage. It was assumed that the mean score of material utilization has the highest ratio. Then, it was also anticipated that, except for one design work (number 8), the mean scores of the other twenty-four works increased in design elements relative to design principles. Hence compared to design principles, design elements have a higher ratio of creative level in student work. (see Table 4).

Given that the majority of the scores did not present a normal distribution, the non-parametric Friedman's ANOVA test was used to determine whether design work scores in three items of elements of creativity had a relationship that could help test the null hypothesis*: "There is no relation between the design principles, design elements, and material utilization in product creativity*`. Based on the results seen in Table 5, there was a significant relationship between design principles, design elements, and material utilization, and the null hypothesis was rejected. (p<.001).

The non-parametric correlations between the related contents of design principles, design elements, and material utilization were analyzed via Spearman Rank Correlation (ρ) (see Table 6). The irrational aspects of design principles scores and the limited material utilization were highly correlated (r = .633). Although irrational aspects of design principles score were also correlated with contrast and juxtaposition principles, respectively (r=.411, r=435). Additionally, the interactive aspects of design principles and the dynamic design principles were correlated (r = .481). Also, the overlap of design principles score was correlated with the space, dialogue with objects, and highly correlated with articulation, respectively. (r=405, r=453,r=614) . The adaptation aspects of design principles scores and the diversity scores were correlated too (r = .409). Moreover, the interpenetrative aspects of design principles scores and transformative were correlated (r = .420). Also, the unity of design principles was correlated with randomness. (r=.396), and finally, space was correlated with dialogue with objects (r= .397).

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Following these positive correlations, there were several negative correlations between the items. For instance, the improvisational aspect of design principles was negatively correlated to scale and irrationality, respectively. (r=-.407, r=-.462) . On the other hand, diversified material utilization was negatively correlated to irrationality as a design principle (r=-.408). As last, dialogue with objects and limited material utilization were negatively correlated. (r=-397)

Table 3 The Mean scores for the elements of bricolage as the creative product

Elements of bricolage as creative product		$\overline{x}$
Design principles	diversity	2.20
	irregularity	2.44
	Randomness	2.30
	Transformation	2.04
	interpenetrative	2.05
	unity	2.30
	fluidity	2.37
	contrast	2.34
	dynamic	2.21
	articulation	2.54
	overlap	2.36
	juxtaposition	2.39
	adaptation	2.84
	irrational	2.60
	interactive	2.44
	improvisation	2.33
	Mean	**2.36**
Design elements	scale	3.29
	texture	3.25
	shape	3.12
	form	3.08
	space	2.80
	Mean	**3.22**
Material Utilization	Limited	3.86
	Diversified	4.18
	Dialogue with object	3.36
	Mean	**3.80**

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Table 4 The mean scores for each student's work related to the association between the elements of bricolage as the creative product

Student work no	MEAN SCORES			
	DESIGN PRINCIPLES	DESIGN ELEMENTS	MATERIAL UTILIZATION	AVARAGE
1	1.73	3.39	3.89	2.50
2	2.29	2.67	4.33	2.82
3	2.08	2.89	3.89	2.96
4	1.98	2.78	3.67	3.10
5	2.31	3.06	3.22	3.40
6	2.84	3.61	3.33	3.95
7	2.98	3.89	4.33	4.55
8	3.00	2.56	4.22	4.44
9	2.51	3.06	3.56	4.53
10	2.20	3.50	3.44	4.79
11	2.18	4.06	3.78	5.25
12	2.18	3.61	3.89	5.42
13	2.76	3.72	4.00	5.87
14	2.37	2.39	4.56	5.83
15	2.24	3.72	3.89	6.21
16	2.33	4.00	3.33	6.42
17	2.27	3.56	4.11	6.74
18	2.20	2.89	3.67	6.69
19	2.51	2.72	2.67	6.72
20	2.18	2.44	3.11	6.93
21	2.16	2.78	3.33	7.32
22	2.76	3.39	3.67	7.96
23	2.27	3.33	4.56	8.29
24	2.37	3.00	4.33	8.43
25	2.49	3.72	4.33	8.89

Table 5 Friedman's Two-Way ANOVA Test Results concerning the elements of bricolage as creative product

Friedman's Two-Way Analysis		
Elements of Bricolage as Creative Product	z	p
DP/DE	17.640	<.001
DP/MU	25.000	<.001
DE/MU	21.160	<.001

**DP: Design Principles , DE: Design Elements, MU: Material Utilization*

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3.3 Discussion

How bricolage contributes to the effectiveness of creative elements in product creativity. Within the context of the suggested model, the study's findings are examined according to the three related issues. Examining bricolage as creative product aided the comprehension of design features and the discovery of the connections between design principles, design elements, and material utilization. Understanding these relationships may assist in the development of design assignments in a design studio, hence facilitating the development of the abilities required to generate more creative products in the design studio.

Overall, the ratings for each factor of bricolage reveal that material utilization received the greatest mean score. Also compared to design principles, design elements have a higher ratio of creative level in student work. Material utilization such as limited and dialogue with objects were found to lead to more creativity, compared to material diversity. Given that limited use and dialogue of the materials are the most essential components of bricolage, this result indicates that the students have a solid understanding of the logic of bricolage. But on the other hand, the creativity level of design principles has the lowest ratio, where these aspects play a crucial role in bricolage thinking. Thus, the capacity to apply design principles requires more concentration and effort by the students.

The highest correlation was found between irrational aspects of design principles and the limited material utilization. Further, irrationality was correlated with contrast and juxtaposition. The essence of bricolage is the creation of a product within limited and finite set-based activity. Besides irrational thinking eventually contributes to the association of bricolage with illogical and chaotic behavior, which is related with a view of the concept's meaning as incomplete and unstable. (Spychalska-Stasiak, 2020). Moreover, juxtaposition is the act or occurrence of associating two or more items, often for the purpose of compare or contrast. From this perspective, the findings support the idea that irrationality in creative activity may be induced by juxtaposing opposing forms. However, it was found that irrationality was negatively correlated with improvisational aspect of design principles and also with diversified as one of the material utilization issues. We did not expect this kind of result, where bricolage is characterized by its irrationality, and improvisational and diverse nature. The negative correlation between irrationality with diverse usage of material, that has the highest mean score, was also an unexpected outcome. Because we assumed that irrationality has a strong relation with diverse utilization of the materials. So, the findings guided us to acknowledged, that irrationality is about thinking process not product.

Improvisation is defined as a creative act composed without prior thought. (Gerber, 2007) , which was the most important scope of the inform/perform assignment. On the other hand, the practices of bricolage and/or improvisation are compatible and can be practiced individually or collectively. (Bouvier-Patron, 2021). From here it can be asserted that improvisation is about incoherence and irrationality. The reason of the negative correlation between irrationality and improvisation can be explained by students were lack of skills and strategies on improvisation as being freshman. Basic design studio, as the initial level in studying design, does not effectively prepare students to improvise. So, the ability of improvising on design products demands more exercise on the part of the students.

Additionally, the interactive and the dynamic aspects of design principles were correlated. As bricolage; indicates directness, illogical, and intuitive phenomena, using uncertainty, improvisation, and interactive processes is an illogical activity since it encourages designers to evaluate dynamic potential solutions. (Le Loarne, 2005). The findings of the study support this idea and that the product as bricolage is an interactive activity related to dynamism of the artifact.

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On the other hand, findings denote that overlap as a design principle was highly correlated with articulation and also with the space and dialogue with objects. Bricolage is an approach that expresses the renewal, articulation in order to produce new structures (Levi-Strauss, 1994). Both articulation and overlap in bricolage entail the inventive integration of unrelated pieces into a unified whole. In order to articulate separate aspects, a bricoleur must establish their links and linkages, while in overlapping, the bricoleur must create methods to connect apparently unrelated ideas or thoughts. The bricoleur also need to articulate the connections between the space dialogue with materials. On the basis of this notion and these findings, bricolage articulation may be seen as a technique for overlapping space via dialogue with objects.

Furthermore, the interpenetrative aspects of design principles and transformative were correlated. Interpenetrative refers to the transformation of the form as a specific adaption or version of the design work as the process of spreading from one object to another in all directions. Likewise, bricolage is discussed as an approach that is potentially transformative (Phillimore, Humphries, Klaas, & Knecht, 2016) .Hence, the findings foster the idea that, bricolage as related to interpenetrative aspect of design work can be interpreted as a transformative activity.

The unity was correlated with randomness as design principles. In broad terms, randomness and unity are two concepts that seem contradictory. Randomness refers to the quality of being unpredictable and lacking of pattern or order. In design, randomness can be used to create a sense of spontaneity. On the other hand, unity refers to the quality of being cohesive. Yet with bricolage, randomness may drive creativity and experimentation, while uniformity can provide a feeling of cohesion and harmony in the outcome. Creating an effective bricolage requires striking a balance between two opposing forces. The adaptation aspect of design principles and the diversity were also correlated. Moreover, adaption receives the greatest average score among the design principles. These findings nurture the idea that bricolage necessitates an adaptable approach, since students may need to modify their design strategies as they work with the available resources. When students have more possibilities to work with and may combine various components in unexpected ways, a broader diversity of materials can foster more creativity in bricolage. Moreover, space as one of the design elements was correlated with dialogue with objects in material utilization. This might be understood as students creating spaces by referencing the materials used in bricolage. This outcome was predictable, given that space is a reference to material as a fundamental design approach. As last and the most unexpected outcome was the negative correlation between dialogue with objects and limited material utilization. It might be understood as when the dialogue with objects decreases as the utilization of limited materials increases or vice versa. While this result served no purpose, we must address this circumstance in our future research.

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Table 6 Correlation among elements of bricolage as creative product

		Design Principles															Design Elements						
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**21**
Design Principles	**1.** Diversity																						
	2. Randomness	.356																					
	3. Transformative	.264	.220																				
	4. Interpenetrative	.023	-.038	**.420***																			
	5. Unity	-.081	**.396***	.219	.122																		
	6.Fluidity	-.176	-.071	-.350	-.127	.017																	
	7.Contrast	-.092	.082	.122	.207	.267	.222																
	8.Dynamic	.052	.187	-.147	-.215	-.021	.025	.118															
	9.Articulation	-.102	.364	.208	.289	-.020	-.177	-.019	.129														
	10. Overlap	.015	.341	.135	.264	.032	.187	.045	-.085	**.614****													
	11. Juxtaposition	-.184	.105	-.048	.118	.199	.147	.289	.331	-.058	-.088												
	12. Adaptation	**.409***	-.039	-.146	-.114	-.325	-.336	-.287	-.259	-.164	-.268	-.176											
	13. Irrational	.029	-.042	.034	.025	-.147	.152	**.411***	-.037	.048	.109	**.435***	-.036										
	14. Interactive	-.172	-.105	-.117	-.196	.082	-.071	-.191	**.481***	-.194	-.337	.369	-.115	-.150									
	15. Improvisational	.004	.236	.338	.363	.254	-.276	.023	-.113	.046	-.175	-.133	.074	**-.462***	.023								
Design Elements	**16.** Texture	-.134	.133	.004	-.104	.335	-.036	.099	.038	.010	-.160	.169	.119	-.131	.341	.160							
	17. Scale	.140	-.093	-.338	-.226	-.275	.193	.018	-.065	-.171	.126	.245	.248	.115	.048	**-.407***	-.138						
	18. Shape	-.171	.115	.169	.261	.210	-.070	.185	.274	.030	-.005	.019	-.117	-.146	.092	-.242	.264	-.079					
	19. Form	-.338	-.085	-.318	-.092	.120	.319	.230	-.039	-.274	-.091	.055	-.057	-.188	.069	.010	**.555***	-.075	.052				
	20. Space	-.035	.230	-.234	.085	-.181	.021	.093	-.019	.381	**.405***	-.033	.025	-.001	-.204	.135	-.157	.080	.173	.040			
Material Utilization	**21.** Limited	-.062	-.177	.138	.103	-.002	.061	.174	-.240	-.022	.027	.142	-.098	**.633****	-.108	-.038	-.149	-.080	-.279	-.299	-.002		
	22. Diversified	-.290	-.362	-.083	.136	-.064	-.059	-.208	.233	.168	-.060	.029	-.142	**-.408***	.378	.051	-.106	.069	-.030	-.083	-.084	-.131	
	23. Dialogue with objects	-.119	.209	-.059	.100	.086	-.131	-.204	.215	.365	**.453***	-.011	-.189	-.356	.141	.215	.256	-.217	.225	.085	**.397***	**-.397***	.047

*Correlation is significant at the 0.05 level (2-tailed)
**Correlation is significant at the 0.01 level (2-tailed

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IV. CONCLUSION

The purpose of this study is to develop and verify an approach to address the contribution of the concept of bricolage to product creativity in the design studio environment. Results showed that material utilization received the highest mean score. Also compared to design principles, design elements have a higher ratio of creative level in student work. Students were capable of using design elements creatively more than design principles. It seems that design principles have less contribution to the process of designing. This demonstrates the requirement for a new educational strategy to raise a studio-wide understanding of the design principles of bricolage. The factors that promoted bricolage as a creative product were found to include making the assignment's aims obvious from the very beginning, which helped students become aware of the creative process. The method used in this study may be utilized to construct a studio setting in which students can work to broaden their creative ideas and develop their design skills. Similarly, exposing students to a bricolage-based creative approach may result in more creative outputs.

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2. Authors have permission for the use of software SPPS Version: 29.0.0.0(241), authorization code, which is 5724cb6a58630760f9db

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