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RESERACH PROPOSAL OUTLINE

MEASURING THE EFFECTS OF CREATIVE IMAGERY ABILITIES IN DIGITAL DESIGN PROCESS

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Research Proposal Outline

1. *Problem Statement and Motivation*

Evaluation of creativity is deemed necessary in architectural education and students are expected to develop creative thinking skills. Also, the design is an interdisciplinary activity that focuses on creativity and innovation as it is the source of social change. Creativity is a concept that is discussed within different scientific approaches that are highly discussed in the design discipline. The nature of design is deemed as a cognitive phenomenon but also it is not independent of cultural context. Today, our understanding of design creativity and innovation has been affected profoundly by the emerging novel computational technology. According to Oxman (2006), digital design media have fostered theories, concepts and models of design but "beyond their instrumental functions advanced digital and computational environment are also becoming tools for thinking design" (Editorial board of IJDCI, 2013). So, the digital creativity may take its specific place as a new term in the creativity research literature. The focus of present study is to investigate how the computational design tools interrelate with creativity and the role of individuals' imaginary while they are creating a design product in a distinctive way.

Part of the aim of this study is to combine the cognitive approaches and ethnomethodological approaches in the research field of digital creativity. From the perspective of cognitive science, the term of creativity is subjective and contextual. In brief, this approach "seeks to understand the mental representations and processes underlying creative thought" using both human subjects and computer stimulations of creativity (Sternberg and Lubart, 1999:7) (creativity.netslova.ru). Indeed, the phenomenological or ethnomethodological approach also contributes the issue of subjectivity through its focus on experience and meaning. However, there is certain differences between these approaches in their practices of data gathering and data analysis which can be defined and separated as two primary methods, quantitative and qualitative.

To sum up, the first aim of this study is to adapt the different empirical and theoretical approaches through emphasising on creativity as an multidimensional construct. In addition, the phenomenological view of digital creativity is poorly questioned. In the literature, a study investigating the perception of creativity changing in algorithmic design culture and /or the design groups (individuals, studios or academics) dissociating from each other in understanding the term of creativity was not encountered. It is necessary to question the importance of creative approaches in algorithmic design environment and there is a need of more empirical evidence connecting algorithmic design tools and thought processes to the work of creative design. Also, another issue is the evaluation of the creativity which could be quite subjective and assessment standards could not be easily defined. The domain independent aspects of creativity have some common components and these are applicable for each forms of creativity such as design, crafting, music, writing, etc. By analysing the language we use to discuss creativity, we can see what kind of expressions are the most prevalent in academia or discussions in everyday life (Jordanous, 2011). With taking this into account, the definition of digital creativity will address the domain of algorithmic design through questioning how it relates to cognitive functions and different cognitive abilities.

In the first place, the general understanding of digital creativity will be explored among certain groups of designers and universities (in the case of Turkey). Then, as a second step, the digital creativity will be discussed from the perspective of ethnomethodological approach and creative expression of certain design society. The role of creative imagery abilities on algorithmic reasoning in the algorithmic design process will be investigated.

The present study is distinct because it includes an experiment with selected participants giving them a design task related to an architectural issue to investigate effects of their individual cognitive abilities on their digital creativity. The concept will be limited with field search by doing survey and observation through ethnomethodological approach. After applying the methods of ethnomethodology, the assessment of creative products will be discussed through organizing the socio-technical expression about it. The general understanding of digital creativity will be mapped in the computational framework, then this framework will be used as a guideline for assessment. Thus and so, the final products will be evaluated according to these consisted assessment criterias by a group of the selected experts from the several design groups. One of the concerns of present study is to produce more objective design assessment process/criterias for the algorithmic design experiments.

In order to search interrelation between creative imagery abilities and computational thinking in the design processes, the experiments will be done within different kind of computational design media depending on the designers preferences.

The designers can only apply algorithmic tools such as Generative Component, Dynamo, Processing or Grasshopper, etc. However, the selection of design environments will be done after the surveys and questionnaire which will reveal the general preferences and tendencies in digital design tools of the designers. So, the first phase of study will be decisive in terms of determining the conditions of experimental part of the research.

2. *Research Hypotheses*

Hypothesis 1: Different design groups assess creativity in computational tools and visual media differently, and the perception of creativity which is situated and gained from the social environment affect the individuals' design actions and software behavior.

Hypothesis 2: The individual differences in cognitive style affect the creative imagery and imagery skills help designers in handling with a computational design problem.

Hypothesis 3: Different cognitive abilities are related to different forms of creativity. So, algorithmic reasoning abilities of designers affect their productivity in the computational design environment.

3. *Research Questions*

1. How digital creativity can be investigated through the ethnomethodological approach in the field of computational design (in the case of design groups and media)?
2. Do the individual differences in imagery have an important role in being creative during the algorithmic design process for designers? How?
3. Could practical methods to enhance computational (digital) creativity for the distinctive design process be developed by applying and supporting the principles of creative imagery?

4. *Short Literature Review*

The design process still seems like a range of creative actions by the designers in the field of architecture. However, the design process has been changing in algorithmic culture and new dimensions of novelty and unexpectedness have been added into this process. Architects could have different cognitive style or tendencies in digital design owing to their educational, biographical or knowledge background of them. Therefore, their perception of digital creativity can show variance among each other.

According to Oxman (2017), parametric design thinking has its own "strategies and methods for exploring alternatives in a solution space may be unique depending on the type of computational media technology". She presents a term, namely, 'algorithmic thinking' which is written by source code of explicit instructions that start computational procedures producing digital forms. Today, scripting or writing code is a new way of design thinking (Oxman, 2017). Speculatively, the terms of the computational level of design tools (such as the difference between Grasshopper or Revit), as referenced from Oxman (2010), can affect the mental imagery abilities and the way of problem-solving in the design process. However, this statement should be investigated in today conditions, specifically for particular design schools or groups. For instance, in artistic production, the focus was on the digital objects and its phenomenological characteristics, this can be briefly summarized as a cultural behavior that focuses on technology (Vella & Pizzo, 2014). So, in the field of architecture, whether digital creativity indicates the cultural interest and phenomenological extensions or not should be investigated by field research. Thus, the question is what the new dimensions of digital creativity in that situation are. According to Gero (2006), designing is a situated activity. The different environments such as, external, interpreted and expected world, "connected to each other, form the situation which is part of the environment that the designer interacts with" (Gero & Kannengiesser, 2006). It means situations and conditions determine the extent of the creativity of individuals and products.

Sternberg (1999) says that the last 50 years of "research in creativity have been partly speculative with a vague level of theorizing and inconclusive empirical evidence." Thusly, incorporation of theoretical elements from social psychology and sociology in addition to those provided cognitive studies of creativity can give a valuable direction to the research (Gero & Sosa, 2003). According to Gero (2005), the use of a combination of research methodologies moves from speculation to specification and explanation is today's challenge. Thus far, case studies, psychoanalytic approaches, multiple components approach, and psychometric approaches were improved well and these all emphasize "that creativity involves multiple cognitive skills and is not simply as a unidimensional process" (Finke, Ward & Smith, 1992). Although extensive research has been carried out on cognitive style and creativity in architectural design (Akin, 2003; Kokotovich & Purcell, 2000; Verstijnen, 1998; Bilda, Purcell & Gero, 2006), no single study attempted to integrate of the creative imagery test into the experimental research.

Test-based research on creativity remained the dominant approach in creativity research for many years (Karwowski & Jankowska, 2015). Most of the tests are based on measuring the characteristics of divergent thinking theory of Guilford (1950 as cited in Karwowski & Jankowska, 2015). According to Karwowski and Jankowska (2015), the scoring criteria in "new creative imagination tests were still a reproduction of fluency, flexibility, originality and elaboration." So the originality of imagery should be measured through assessing the components of creative imagination which are vividness of imagery, originality of responses and transformative imagery ability. Also, the important point is the measurement of domain specific creativity problem. Lastly,

the issue of neural correlates of creativity and the key role of brain areas involved in motor imagery on highly creative individual was highlighted (Aurora, 2016; as cited in Palmiero, 2016). So there could be some differences between domain specific creativity (e.g. visuo-spatial or verbal, musical) and general creativity in terms of specialized brain region. The debate about the best strategies for the assessment of domain specific creativity and its relations with mental imagery abilities continue. For instance, Kozhevnikov et al. (2005) found that while visual artists tended to have object imagery abilities, the spatial abilities are also important for higher-order thinking in science and mathematics. So, in the present study, the some of the cognitive style tests will be conducted before the experiment in order to understand the differences between cognitive factors to be accepted as creative in algorithmic design environment. Their test scores will then be evaluated on the basis of data acquired after these tests. The expected level of performance during the design task for a given individual will be based upon their personal differences in education or belongings.

Keywords: digital creativity, situated creativity, phenomenology of digital technology, creative cognition, cognitive style, algorithmic design.

5. Methodology of the Research Study

In design cognition sciences and creativity researches, the tests of creativity have been developed and lots of researches have been done from the perspective of mixed methodology. In our study, it will be attempted to introduce the new methods that have not been implemented into creativity researches so much up to now. According to one of the review studies about research methodologies, very few qualitative studies about creativity have been published in the 5 prestigious creativity journals so far (CRJ, JCB; GCQ, PACA) (Long, 2014). The same author also draws attention to the "methodological rigor or more discussion of methodological issues in the creativity studies." Therefore, the use of qualitative methods should be a well-established approach in the creativity research, and also it should distinguish itself from others. Actually, for this study, we have a different perspective about the methodology. So, our methodology could be accepted as a mixed method study. Because in the experimental part the study, it will be used the quantitative (statistical) technics in data analysis and correlation analysis.

In the first phase of the study, the ethnomethodological perspective is adapted to find out the creativity perception of design group while seeing them as a cultural member of determined design community (Figure 1). Then, we elucidate the terms of digital and computational creativity through gaining data from these design groups.

- **Ethnomethodological approach: Survey and conversation analysis**

The scientific perspective of ethnomethodology declares that the natural language of a social group reflects its own view and perception about the facts. It is the practical state of the phenomenology that emphasizes the dialectical relationship between the individual and the structure, and tries to understand the factors that affect the subject's perception process (Harvey, 2019). This view also accepted as *social phenomenology*, so at the beginning of the proposal, it was preferred to use the phenomenological perspective for the general approach. We could derive information about the viewpoint of the digital creativity of the members of design groups (e.i. non-randomized 100-120 person will be selected) through making a content analysis of design media.

- **Content analysis of digital design media**

The content of digital design media will be analyzed by using qualitative technics. So, the mostly repeated, stressed concepts and figures (images) among the digital design media will be captured and then will be coded with using the qualitative analyzing software (e.g. NVivo, ATLAS.ti). A more comprehensive study would include all the

definition of concepts and sub-concepts in algorithmic design. It is essential because it can show us a map of concepts and its relations with other domains such as science and arts. Additionally, before implementing the experiment, a much more systematic approach has to be used to identify how the visual imagery components and tests interact with other variables which are believed to be linked to creative imagery.

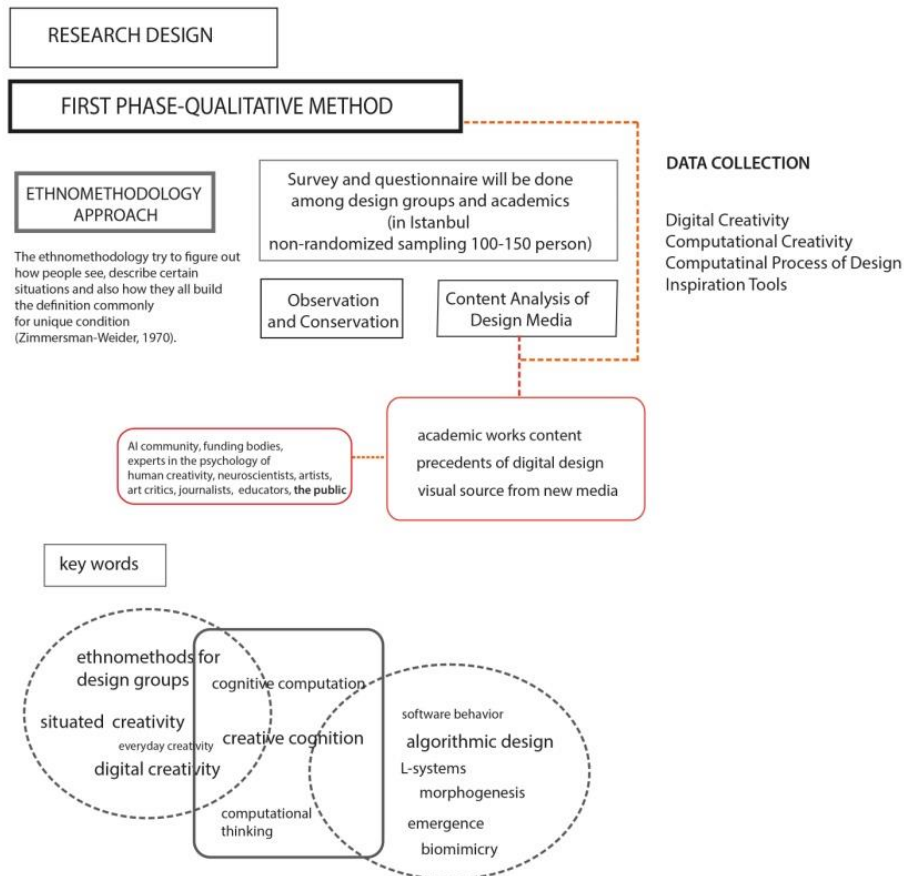


Figure 1: The first phase of the study.

To sum up, the question is what kind of imagery and behavior patterns have an effect on producing something 'creative' with the collaboration of algorithmic design tools. So, the terms of creative cognition and imagery will be discussed and measured in that vein.

- **Cognitive tests**

In the second phase of the study, the design experiments will be implemented among the members from selected design groups (e.i. 20 to 30 designers). To measure individual differences in imagery, several tests will be applied (Figure 2). Mental imagery theory has long a special place in psychology. The type of imagery, visual, object-spatial or spatial style continue to be a research area in imagery and a lot of studies and tests have been done to figure out their differences if there is any. In this study, we try to understand the mechanism of algorithmic creativity which is used, in here, as a digital creativity. Actually, in algorithmic design, different kind of reasoning could be used by the designers.

- **Algorithmic design environment**

Here, what we are trying to do is revealing the mechanisms of the algorithmic design thinking process and also encouraging the design process to come together with creative thought based algorithmic reasoning rules. The design brief will be given the 20-30 selected designers and their design and software actions will be captured and observed during the design process. Then the experiment process will be coded by protocol analysis which is referenced to Gero's Function-Behavior-Structure (FBS)

ontology. In this, "researchers argue that is capable of capturing most of the meaningful cognitive aspects of design with its systematic coding" (Ostwald et al., 2018).

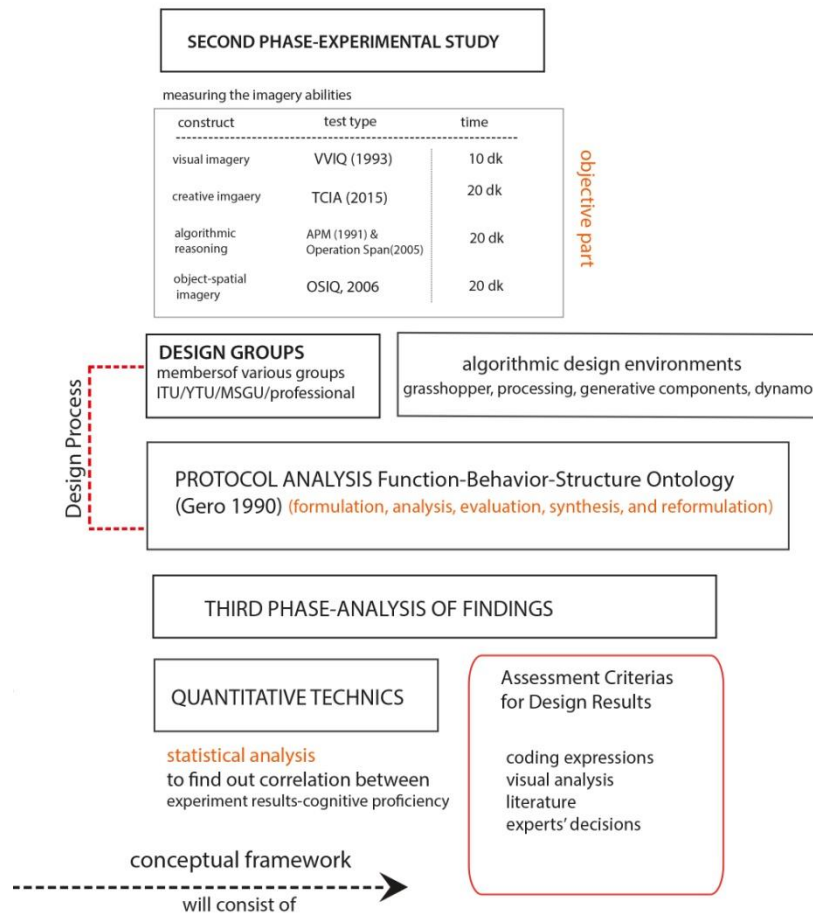


Figure 2: The second phase of study.

- **Assessment of protocol analysis and statistical analysis**

In the last part of the research design, the findings and codings will be correlated and analysed by quantitative technics. Also the selected experts will evaluate the results in order to their level of digital creativity using the prepared conceptual framework. On the other hand, statistical tests like two independent sample T-test and regression analysis will be applied to find out the relation between the cognitive tests and creative design process of participant. The final products will be evaluated separately and their correlation between the design processes will be analyzed differently.

6. Expected Outcomes

The one of the expectation from this study is to find out the strong correlation between the level of digital creativity in the design results and cognitive proficiency of participants. Particularly, the high level algorithmic reasoning abilities and spatial imagery abilities would affect that the productivity in algorithmic design process. So, with the codings and findings of protocol analysis which is based on the F-B-S ontology, the process and software action will also affect the evaluation of design results and its relation with cognitive differences of participants.

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