International Journal of Architectural Engineering & Urban Planning, Volume 32, Number 2, 2022
DOI: 10.22068/ijaup.528

Research Paper

Creativity, Design Studio Performance, and Social Media: A Study of Instagram Use among Architecture Students

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Received: January 2021, **Revised:** December 2021, **Accepted:** December 2021, **Publish Online:** December 2021

Abstract
The importance of using visual social media as the digital learning and inspiration resources in architecture is blatantly obvious. On the contrary, there are still gaps in the position of those platforms in the elements of creativity and performance within design studios. The major research question is how does the architecture students' use of architectural content on Instagram relate to their creativity and design studio performance? The paper aims to determine the relations of defined Instagram usage parameters with creativity indicators and students' grades in studios. After crafting the theoretical framework, the correlational research method was used to define the correlations between variables by Spearman's correlation coefficient. All 72 students of the Design Studio III course during 2018-2020 at Tabriz Islamic Art University reported their Instagram usage parameters and design grades. Their creativity was measured by Abedi's version of the Torrance Test of Creative Thinking, and the data were analyzed using SPSS software. Results revealed significant and positive correlations between the students' performance and the overall score of creativity, fluency, and originality; but, no correlation was found in elaboration and flexibility. Also, there is a significant and positive correlation between Instagram use and flexibility of creativity. However, no significant correlations were reported between Instagram use and their studio performance. Hence, despite enhancing the flexibility, students cannot consider Instagram as a tool to achieve success in studios. Furthermore, the assessment system of the studios in Iran doesn't cover all aspects of creativity, and it's crucial to construct a new architecture-oriented creativity test.

Keywords: *Creativity, Design studio performance, Architectural design, Social media, Instagram.*

1. INTRODUCTION

The transition of inspiration resources of architecture students from printed magazines to new media in the design process has enabled them to connect to more up-to-date resources with a higher level of quality. This revolution has led to new horizons requiring studies on architecture students' training both in the design studios and outside. In recent years, the lifestyle of architecture students have been integrated with daily digital platforms, and the quality of this integration originates from their different aspects of characteristic. This shift results in a wide variety of levels in their artistic and architectural creation outputs.

Many scholars claim that creativity is a factor in humans, influencing the design process and design outcomes (Aderonmu et al., 2017; Nagai & Taura, 2016). Although some studies indicate that creativity in design is related to instinct-driven nature, numerous research studies define it as a nurtured quality with the possibility of improvement (Cross, 1990). Advocates who believe in the fact that creativity can also be enhanced presented different approaches to its reinforcement. One of the leading solutions is the eye-centered approach. In this approach, the level of dependence on eye and visual

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aspects is higher than other senses. This will result in everything being measured based on the level of ability to display or to be displayed (Onur & Zorlu, 2019). So from this point of view, visual training among architecture students relates to their creativity level. Therefore, the more architects enrich their mental visual resources and archives, the more creative they can deal with the architectural design challenges and their design process.

On the other hand, academic performance is defined as intelligent progress in education demonstrated by students' grades and ranks (Astin, 1999). Hence, students' grades in design courses are the primary indicator of their design studio performance (Nazidizaji et al., 2015) and the ability to utilize related skills in the design process (Chiu, 2015). Thus, in the design studio course, the element of creativity is present besides other factors affecting the design studio performance. But, it has a more prominent and influential role in the final results and design outputs in the design studio course.

According to the eye-centered approach mentioned above in improving creativity and the crucial role of creativity in design studio performance, new media integral to architecture students' lifestyles influences these two features in design studio courses implicitly and explicitly. Since the enrichment of visual archives in architecture students' minds is one of the cardinal ways to increase design-related creativity, Instagram as the popular example of visual social media is influential among these interactions. Although the impacts of using visual social media on design students are blatantly apparent nowadays, there is still a gap in the literature to focus on the position of those platforms in the two main elements of creativity and performance within design studios that this study seeks to bridge.

This paper investigates the relationship between the three main variables of Instagram use, creativity, and academic performance of architecture students and their associated parameters in a specific design studio course. The study helps to understand social media's position in architecture students' lives and its effect on design studios in specified curricula related to their creativity. Therefore, the major research question is that how does the architecture students' use of architectural content on Instagram relate to their creativity and design studio performance? Also, three minor research questions would be defined as follows: 1) Is there a significant correlation between creativity indicators and design studio performance of the architecture students? 2) Is there a significant correlation between Instagram usage and the design studio performance of the architecture students? 3) Is there a significant correlation between Instagram usage and the creativity indicators of the architecture students?

The current research verifies three hypotheses. The first hypothesis states a significant and positive correlation between creativity and its scales and the grade of design studio courses as the indicator of architecture students' design studio performance. The second hypothesis states a significant and positive correlation between Instagram use of architecture students and their creativity and scales level. And the third hypothesis proposes a significant and positive correlation between Instagram use of architecture students and their design studio performance demonstrated in their design studio grades.

2. THEORETICAL FOUNDATIONS AND REVIEW OF THE LITERATURE

2.1. Main Variables of the Design Studios

2.1.1. Creativity

Besides wide diversity in the history of creativity in design, most of the studies indicate the design as a rational problem-solving procedure (Coyne et al., 1990; Jonas, 1993; Nagai et al., 2003; Runco, 1988; Worinkeng et al., 2015). Creativity is the central part of architectural design studios, and it must directly relate to the significant focus and dimensions of the projects (Aderonmu et al., 2017). Designers try to avoid conventional solutions, and creativity plays a crucial role in their success (Cho, 2017). One of the main objectives of educational systems is improving the ability of creative problem solving in students (Runco, 2004).

Design creativity focuses on human-related factors discussed in perceptions, behaviours, and subjective aspects like sensibilities. Two different approaches that connect creativity to the design process are the creativity related to the procedure of designing and the creativity demonstrated in the design outcome (Nagai & Taura, 2016).

Novelty and usefulness of the products are two criteria of creativity assessments, and the designers can be compared with these two items in their products (Sarkar & Chakrabarti, 2011). Criteria of creativity may alter in different design studios' projects and depend on the project title's nature. So, instructors must clearly understand specific factors for a given project and evaluate creativity through each design topic's lens (Aderonmu et al., 2017). The aggregate of creative items that achieve each individual is called that person's creativity (Piffer, 2012).

Several studies have been conducted on improving creativity and how people come up with new and creative ideas and solutions (Roskes et al., 2012). Explicit training was the foundation of most creativity improvement methods in the past. The people had some consciously related pieces of training and tried to learn how to be more creative. But, this method did not guarantee creative improvement, and participants could not show a great deal of creativity in confronting problems and their solutions (Zhong et al., 2008). So, using non-rule-based training related to creativity can improve knowledge nodes in the brain of people (Chiu, 2015).

The role of creativity in students' performance in design courses can be defined more meaningfully by utilizing domain-specific criteria of creativity (Cho, 2017). Consistent findings are missing among the studies on the relationship between creativity and academic performance (Gajda, 2016). The relations are culturally diverse, with the studies conducted in the US moderate to positive (Matthew & Stemler, 2013).

2.1.2. Performance of the Students

In the definition of design, it's a sophisticated problem-solving activity that different cognitive abilities get involved in it. These intangible items are intuition, imagination, and creativity (Zeisel 2006, p. 19). Architecture and design need an average understanding of science and art. There's a tension between scientific and artistic aspects, and the architects must balance their abilities in both categories. So, studying the related cognitive styles and their relationship with students' performance in design studios will clarify the essence of architecture and design (Cho, 2017).

The term "design studio" as the core of architectural design implies a workshop or laboratory that hosts experimental design (Chance et al., 2016), and the instructors teach architectural design and process besides the practice and learning of the students (El-Latif et al., 2020). The design studio is the most crucial course in architecture education. It's a small simulation of professional environments and has the most considerable credit hours in architectural programs (Anthony, 1991; Bunch, 1993).

The difference between the design studio and a regular theoretical classroom lies in the instincts of the places. In the studio, the procedure is hierarchical based on progress and learning stages related to problem-solving solutions. Concepts of design and visual design thinking are often discussed in the studio to enhance students' visual design thinking through techniques and physical models (Abdelhameed, 2011). Also, in lecture courses, exams and tests are the measurement tools in the performance of students. But, in design studios, it is the quality of design process and the final visual results related to learning purposes that plays a substantial role in the students' performance (Cho, 2013), and the final grade of architecture students demonstrates the level of design performance and the ability to utilize relating skills (Cho, 2017). It's essential to measure the architecture students' cognitive skills and the correlations to their design studio grades to enhance the educational system's productivity (Nazidizaji et al., 2015).

Many items can influence architecture students' design studio performance, such as domain-specific skills and knowledge, motivation, emotion, persistence, and interpersonal relations (Nazidizaji et al., 2015; Smith, 2015). As previous studies demonstrated, the results of all the interactions between these features will be shown in the grade that architecture student achieves at the end of the course as the design studio performance.

2.1.3. Creativity and Design Studio Performance

Many researchers conducted numerous studies on design studio performance and creativity with different approaches as two major architectural education topics. After a brief review of these topics, the papers that explored the relationship between the two variables are introduced. The results are reported to have a better understanding of underlying aspects.

Demirkan and Afacan (2012) demonstrated three main design creativity factors to explore creativity and its assessment in design studios. Novelty and parameters relating to the artifact's shape, elaboration parameters integral to geometry and figure-ground relations and harmony of elements, and rhythm, repetition, unity, order, and the number of features are the items that creativity can be measured with them in the design studio (Demirkan & Afacan, 2012).

From another perspective, Nagai and Taura (2016) studied design creativity from cognitive and social perspectives by analyzing the foundations of design creativity and examples of criticism. Their study examined the methodological challenges that influence creativity in design and surveyed the methods of assessments in creativity relating to the design (Nagai & Taura, 2016). Onur and Zorlu (2019) conducted a study with 60 architecture students, and their level of creativity was measured using the Torrance Test of Creative Thinking. It was found that multi-sensory awareness education enhances the level of creativity in students (Onur & Zorlu, 2019).

In the topic of creativity with a novel approach, Chiu studied the impacts of overinclusive thinking training on enhancing creativity. In the experiment related to the creative thinking test, he divided undergraduate students into two different groups. The first group received overinclusive thinking training, which resulted in higher fluency and originality than the control group. So, there was a direct correlation between overinclusive thinking and creativity in fluency and originality sections (Chiu, 2015).

Papers related to design studio performance indicate several aspects affecting architecture students' design quality in the design studios. In an exploratory analysis among U.S. college students, five major design thinking factors related to the architecture students who demonstrated better performance were mapped: collaboration, experimentalism, optimism, feedback-seeking, and integrative thinking (Blizzard et al., 2015). Different architecture students prefer different learning styles. There are several reasons for this distribution, like cultural diversity (Demirbaş & Demirkan, 2003; Demirkan & Demirbaş, 2010) and different learning styles of architecture students have correlations with their design studio performance (Kvan & Jia, 2005).

Cognitive style is another parameter affecting the progress and performance of architecture students in design studios. Roberts (2006) studied the students' different cognitive styles and performance at some specific architectural design stages in studios. The paper concluded that although different cognitive styles impact design studio performance, this effect decreases gradually as the student completes design studios through the years of learning (Roberts, 2006). Wang et al. (2019) found that studio tutorials do not directly affect design studio performance. However, the students' ability to convert external factors like instructors' efforts into internal characteristics plays a crucial role in the interrelations between these two parameters. So, this external force has an indirect effect on the design studio performance of architecture students (Wang et al., 2019).

However, inadequate studio facilities, lack of reading culture, insufficient staffing, inadequate funding, over-admission, and wrong admission are factors that weaken the students' design studio performance (Nwankwo et al., 2014). Aderonmu et al. (2017) published a paper that focuses on the assessment methods in architectural design courses in the case studies of four selected Nigerian universities. The study implies different challenges in evaluating the designs for grading like bias, fear, intimidation, etc., that can mislead jurors. They found a dialogically comprehensive parametric process as a solution to address the problem constructively (Aderonmu et al., 2017).

In the relationship between design studio performance and creativity, Cho (2017) conducted research that helps us define the current research procedure. This study aimed to investigate the relationship between creativity, spatial ability, visual cognitive styles, and architecture students' design studio performance. The quantitative parameters in 59 architecture students who participated in the study were measured using related tests like Torrance Tests of Creative Thinking. The analysis demonstrated that the studio course grade variable and other variables mentioned above do not correlate. So, the performance of architecture students in the design studios cannot be predicted and measured directly by creativity (Cho, 2017). However, in other studies, various correlations from weak to moderate were found between academic performance and creativity (Gajda, 2016; Matthew & Stemler, 2013), to the extent that creativity is introduced as the most essential factor in design performance with the tutor's highlighted role (Paker Kahvecioğlu, 2007).

As mentioned, several external and internal factors affect design performance in the studio. Both of them seem to be practical, and creativity is among them. External factors do not influence the performance directly. Instead, by taking external materials from the tutor of other environmental factors, the individual transforms the concepts into internal patterns and uses them directly. As it seems, surprisingly, the results are not concrete and divergent enough that possibly be expanded to different studios in different contexts regarding the relationship between design performance and creativity. Therefore, the present study seeks to find an overview of the topic in a developing country and improve the clarity of these relationships in Iran's community of architecture students.

2.2. Social Media in the Design Studios

People can generate concepts and share them with others in Internet-based programs called social media (Kaplan & Haenlein, 2010) With social media's help, the academic elements can be promoted in learners, both in formal and informal environments, by sharing resources, science, and skills (Palonen & Hakkarainen, 2000). Studies on social media and educational management systems' integration demonstrated that informal learning would increase with social media's help in educational systems. By using this new platform, the learning process will be transferred out of the classroom, and its scope will be more comprehensive (Gremu & Halse, 2012).

Therefore, it can be acknowledged that, along with all the uses, the role of the educational use of social media is increasing gradually, and this subject cannot be ignored in the educational context.

2.2.1. Creativity and Social Media

One of the studies related to social media and creativity was conducted to examine the critical content factors of Instagram use and its users' personality differences. It was reported that the motivation factor of creativity, along with five other motivation factors of self-expression, recording, socialization, recreation, and prying, was among the context-specific usage motives of Instagram (Kocak et al., 2020). A study by Acar, Neumayer, and Burnett (2019) showed that social media is not only not necessarily a negative factor for creativity but can also be used as a helpful platform to support new ideas and projects (Acar et al., 2019). Salehudin et al. (2020) examined the impacts of learning models assisted by Instagram on design students. They reported that in high and low user experience students, project-based learning supported by Instagram and creative learning assisted by Instagram are the most suitable learning models (Salehudin et al., 2020). Another study aimed at increasing the understanding of interaction with followers on Instagram demonstrated that perceived creativity is one of Instagram's defining aspects. Also, positive emotions and significant commitment mediate the relationship between perceived creativity and the purposes of interactions (Casaló et al., 2020). Considering the mediating role of intrinsic motivations and the use of social media among students, research findings showed that this usage positively correlates to the students' creativity and academic performance (Malik et al., 2020).

It is argued that social media is a platform for students to express their thoughts, ideas, feelings, and creativity. Nevertheless, it can overwhelm students when they need to engage in practical and constructive activities and take them away from their primary goals (Elantheraiyan & Shankarkumar, 2019). Therefore, by reviewing the research background in creativity and social media, a wide range of studies confirm the direct relationship between these two concepts. But, in some cases, in students' excessive use of these technologies, the opposite results may happen. However, there is a gap in the relationship between creativity in architecture and social media use in the papers.

2.2.2. Design Studio Performance and Social Media

In a study on social media-based learning in the design studio, Güler (2015) compared and analyzed the effectiveness of design studio courses in the states of traditional and social media-based. By using Facebook as the selected social media, the results revealed that variables of ease of communication, unlimited exposure to peer progress, and achieving and backtracking capabilities obtained from social media had positive impacts on the students' performance (Güler, 2015). In another paper, the role of feedbacks related to the design studio outputs on social media was examined. The students used Facebook as an infrastructure for criticism, and the results demonstrated the progress in the students' design studio performance by using this tool (Vo, 2019). Cho and Cho (2020) reported the social media use of design students in a design studio course from the perspective of collaborative design. The interior design students admitted that they use social media in three main categories: searching, sharing, and communicating. These categories are used in three different design stages: comprising the issues, concept development, and design development. So, this behaviour results in a more effective and

enhanced studio performance. (Cho & Cho, 2020).

Few studies have been conducted on the relationship between design studio performance and social media use. Although the studies had different approaches, they all emphasized the positive effect of using social media on the students' performance in the design studio course. This issue is studied to examine this neglected part between the topics and bridge this gap in the current study. The Theoretical model and the research framework have been demonstrated in Figures 1 and 2, respectively.

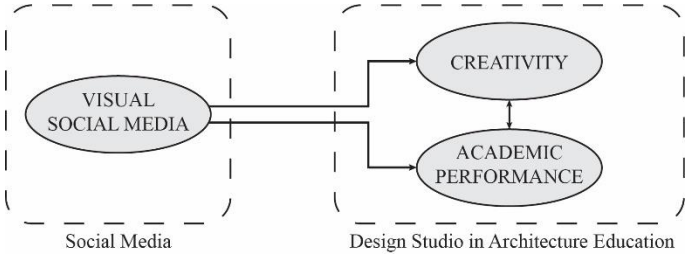

Fig 1. The Theoretical Model

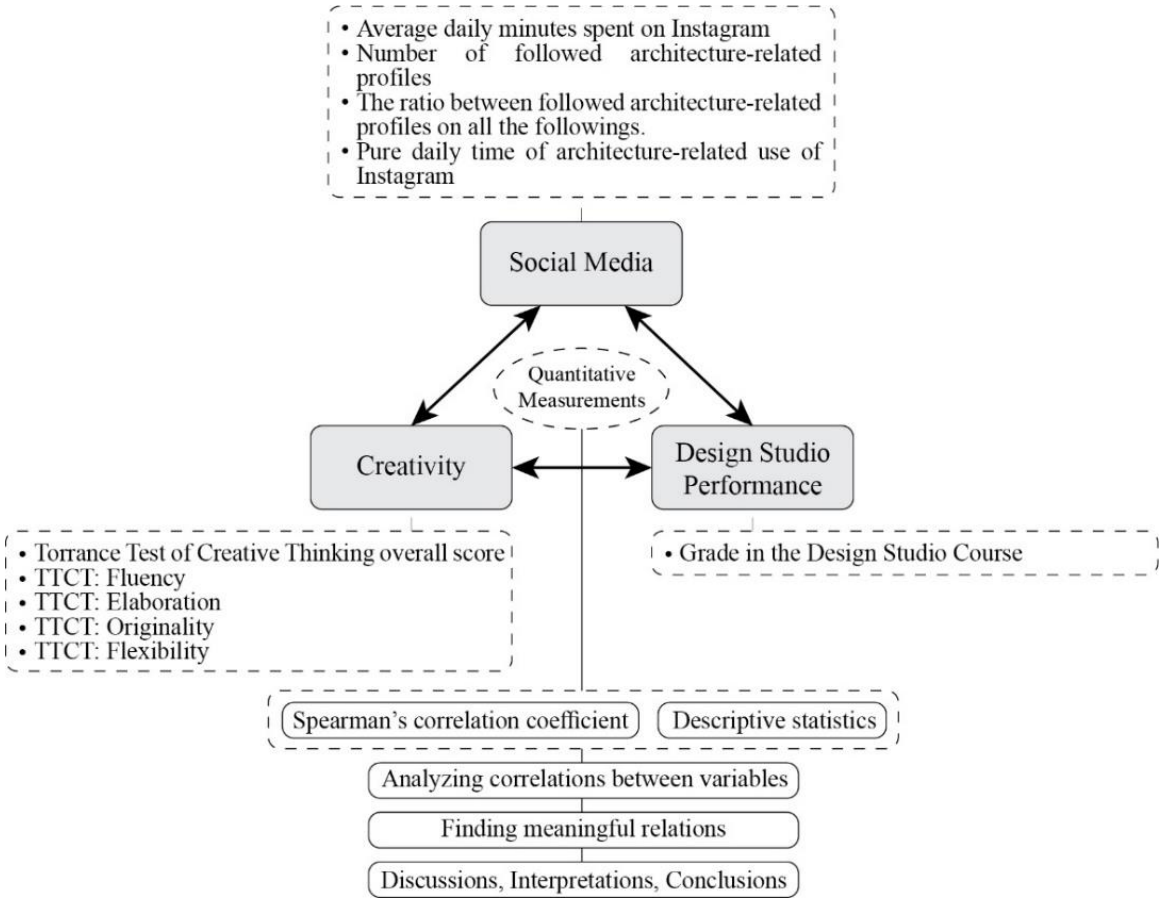

Fig 2. The Research Framework

3 MATERIALS AND METHODS

3.1. Case Study: Instagram

Photographs are tools of studies in empirical aesthetics, and large datasets of photo-sharing platforms of social media like Instagram enhance this form of integration (Thömmes & Hübner, 2018). Instagram acts like a one-handed virtual gallery, and communicating with photos is the primary purpose of Instagram use (Verdina, 2013). Instagram makes an excellent opportunity for people who want their visual works to be demonstrated to the public while they can get feedback directly from the community in a fast way (Thömmes & Hübner, 2018). With these potentials available, Instagram was selected as a suitable platform for studying architecture students. Unlike many other social networks, Instagram is inherently image-based, is the missing challenge that can be explored to the extent of teaching architecture and creativity, and defining specific mechanisms for the development of architecture students.

3.2. Research Sample

All 72 architecture students who enrolled in the Design Studio III course at the Faculty of Architecture and Urbanism, Tabriz Islamic Art University in two academic years of 2018 to 2020 (four semesters in a row) participated in the study. The course Design Studio III was selected for the research due to the emphasis on finding creative solutions in the course among all design studio courses in Iran's undergraduate program. Of a total of 72 students enrolled, only two students (2.8%) did not have any Instagram account, and the others (97.2%), more or less, were among the active users of this social media platform. The data were analyzed from 70 architecture students who were daily users of Instagram and attended the course Design Studio III consisting of 34 males and 36 females.

3.3. Measurement Materials

3.3.1. Creativity, the Torrance Test of Creative Thinking (TTCT)

Torrance Test of Creative Thinking (TTCT) is used in the procedure evaluations to assess creativity and its subcategories level. It has been utilized for more than 40 years in creativity measurements, and it's the most suitable predictor of creative

performance in adults (Torrance & Wu, 1981). TTCT is a general test with an appropriate level of validity and reliability (Cho, 2017). Abedi developed an improved version of TTCT in Tehran in 1983 and investigated its validity. Then, in the US, Abedi and Schumacher invented a 60-item questionnaire based on the original version of TTCT. O'Neil, Abedi, and Spielberger first described this modified creativity test (Auzmendi et al., 1996; O'Neil et al., 1994). Therefore, this enhanced version of the Torrance Test of Creative Thinking was chosen as the current study's measurement tool.

The test has 60 three-choice questions under the sections of fluency, elaboration, originality, and flexibility. According to Torrance, these four parts are the main subcategories of creativity (Torrance & Wu, 1981). Fluency can generate numerous ideas (Abedi, 2002; Chiu, 2015; Guilford, 1975) in limited time and make distant associations. Elaboration is the ability to pay attention to the details. So, different aspects of a specific topic will be developed (Abedi, 2002; Onur & Zorlu, 2019). Originality is unusualness and novelty, and it means the ability to generate new and unusual thinking or ideas (Abedi, 2002; Chiu, 2015; Guilford, 1975; Onur & Zorlu, 2019). And the last subcategory is flexibility. It is the ability to shift approaches and produce multi-dimensional conceptual categories about thinking or product (Abedi, 2002; Chiu, 2015; Guilford, 1975; Onur & Zorlu, 2019). Flexibility plays a leading role in the cognitive process and demonstrates the ability and capacity for change. Flexibility induces the designer to think from different aspects and try various aspects available to find solutions (Nagai & Taura, 2016).

Questions 1 to 22 refer to fluency, and their scores range from 22 to 66. Questions 23 to 33 refer to elaboration, and its scores range from 11 to 33. Questions 34 to 49 refer to originality, and their scores range from 16 to 48. Finally, the questions 50 to 60 refer to flexibility, and its scores range from 11 to 33. The choices demonstrate a low, medium, and high level of creativity. For low creativity, a score of one is given; for medium creativity, a score of two, and increased creativity, three are considered. The sum of each subcategory represents the score of that specific section, and the sum of the four subcategories indicates the overall score of creativity measured by the test. The range of overall creativity score is between 60 to 180, and the more the score tends to 180, the more creative the person will be (Abedi, 2002).

The reliability of Abedi's version of TTCT was measured through students' retest in 1984 using Cronbach's alpha with the results of 0.85, 0.80, 0.82, and 0.84 in fluency, elaboration, originality, and flexibility subcategories. In another test on Spanish students, the results obtained were 0.75, 0.61, 0.61, and 0.66, respectively (Auzmendi et al., 1996).

No published study demonstrates the direct relationship between students' performance in design studios and creativity measured by TTCT in architecture (Cho, 2017). So, by focusing on this test's hidden architectural aspects, the study investigates the relationships between three main variables.

3.3.2. Performance in the Design Studio

In this study, the students' grades were introduced as the design studio performance indicator in the Design Studio III course. The two instructors were the same in studios, and they evaluated the studio's output at the end of the semesters. So, the consistency in grading the students was achieved by the same instruction procedure and the same evaluation framework. The educational system lets the instructors demonstrate the students' performance based on a 0-20 scale, and the students must achieve at least 50% of the overall (grade 10 or higher) to pass the course. Therefore, these final grades were utilized to represent the performance of the students in the design studio.

3.3.3. Instagram Use of Architecture Students

The quality of Instagram use in architecture students is measured by four main parameters. The first parameter is the means of daily minutes spent on Instagram, shown in the "Your Activity" section of the platform. The second parameter is the number of all architecture-related profiles followed by the architecture students. The architecture-related pictures that these pages post every day are shown on the students' Instagram feed. The third parameter is the ratio of followed architecture-related profiles on all the students' following pages on Instagram. This ratio clarifies the relevance of architectural materials among all kinds of posts for the students. And finally, the last parameter is the daily specific/pure time of architecture-related use of Instagram. This parameter is the multiplication of the ratio mentioned above and the average daily minutes spent on Instagram. So, the pure daily time of ar0.chitecture-related use of Instagram will be demonstrated with this parameter. These four factors help researchers find meaningful correlations and results in the current study.

3.4. Procedure

The architecture students of the Design Studio III course participated in this study by completing the questionnaire. This questionnaire consisted of two main parts. In the first part, the students expressed their grades in the Design Studio III course to indicate their design studio performance and their personal view about the related impacts. They reported the quality of their Instagram to use with the parameters of average daily usage time, the number of architecture-related pages that they follow, and finally, the number of all the profiles they follow on Instagram. In the second part of the questionnaire, the participants engaged in the Abedi version of the Torrance Test of Creative Thinking. The questionnaire was distributed in the researchers' presence and online to be accessible to all individuals.

3.5. Data Analysis

Descriptive statistics in the form of tables and graphs were used to analyze the data. In the inferential statistics section, non-parametric tests were used based on the Shapiro-Wilk test of normality due to the abnormal distribution of parameters. To study the correlations between variables, Spearman's correlation coefficient was used with the SPSS software version 25 in the analysis process.

4. RESULTS

The average grade among all 70 architecture students who participated in the study (34 male, 36 female) was 17.99 out of 20 (SD=0.95), 17.68 out of 20 for men (SD=0.91), and 18.29 out of 20 for women (SD=0.90).

The average score of creativity using the Abedi version of the Torrance Test of Creative Thinking was reported 143.00 out of 180 for all the students (SD=12.28), 139.88 out of 180 for men (SD=12.34), and 145.94 out of 180 for women (SD=11.63). So, women performed at a higher level of creativity than men in TTCT.

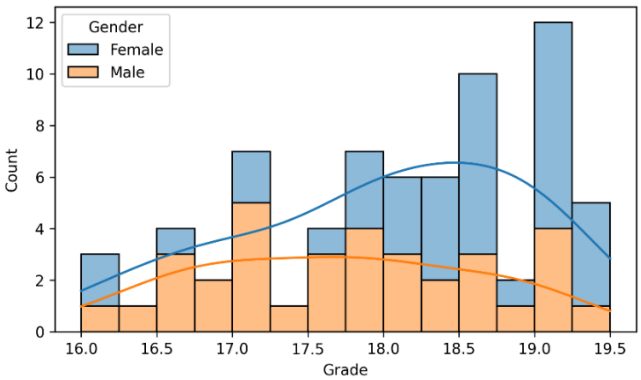

Fig 3. Design Studio Performance of the Students

Table 1. Creativity Test Scores and Subcategories

	Gender	Frequency	Minimum	Maximum	Mean	SD
Torrance Test of Creative Thinking Overall Scores	M	34	94	165	139.88	12.34
	F	36	112	165	145.94	11.63
	Total	70	94	165	143.00	12.28
TTCT: Fluency	M	34	36	62	52.88	4.58
	F	36	41	64	54.64	4.11
	Total	70	36	64	53.79	4.40
TTCT: Elaboration	M	34	12	31	23.32	3.48
	F	36	17	30	24.83	3.01
	Total	70	12	31	24.10	3.31
TTCT: Originality	M	34	28	43	36.38	3.71
	F	36	28	44	38.22	4.08
	Total	70	28	44	37.33	3.98
TTCT: Flexibility	M	34	18	31	27.29	2.67
	F	36	22	33	28.25	2.69
	Total	70	18	33	27.79	2.70

The students' average number of following pages was 583.13 for all (SD=465.95), 562.50 for men (SD=478.52), and 602.61 for women (SD=459.69). By extracting the number of architectural-related pages that the students follow on Instagram, it was reported that the average number for all was 94.93 (137.27), 92.09 for men (SD=123.72), and 97.61 for women (SD=150.65).

Figure 5. Students' all Following Pages and Architectural-related Following Pages

Participants were asked about their personal views on the impact of Instagram use on their design performance level. The results revealed that 87.1% of the participants (61 out of 70 students) significantly by choosing "medium", "high", and "very high" choices admitted that their Instagram use affects their design studio performance.

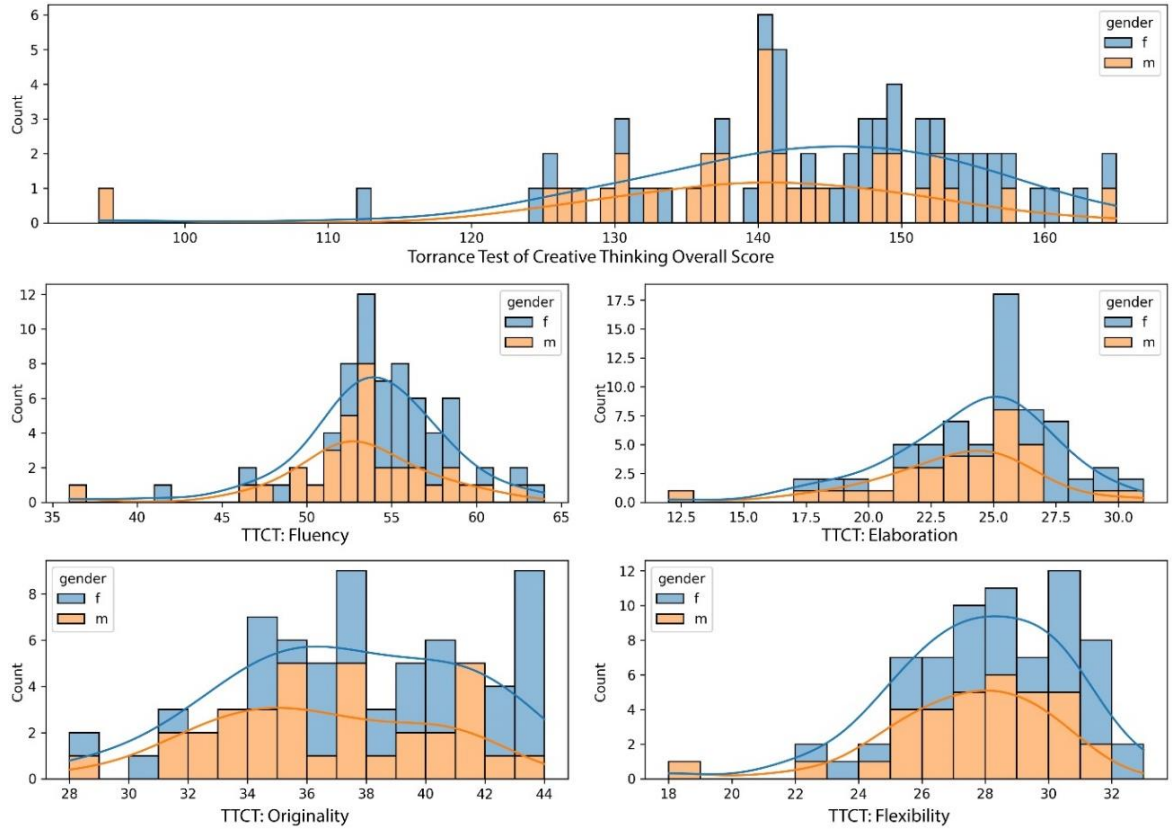

Fig 4. Creativity Scores of the Students

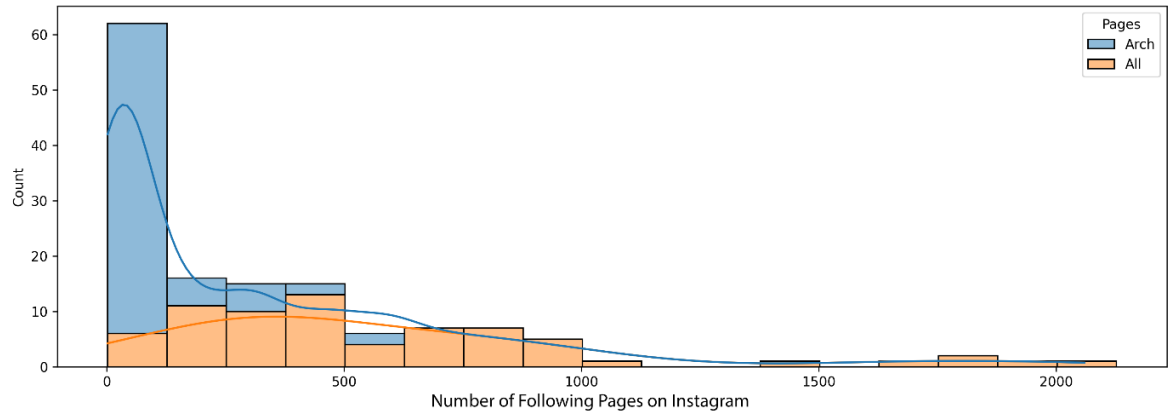

Fig 5. Students' all Following Pages and Architectural-related Following Pages

Table 2. Bivariate Relationships between Variables

Variable	Total (N=70)									
	1	2	3	4	5	6	7	8	9	10
1. Grade (Studio Performance)	1.000									
2. TTCT Overall Score	.352**	1.000								
3. TTCT: Fluency	.321**	.845**	1.000							
4. TTCT: Elaboration	.217	.793**	.614**	1.000						
5. TTCT: Originality	.410**	.905**	.729**	.626**	1.000					
6. TTCT: Flexibility	.138	.694**	.384**	.478**	.529**	1.000				
7. Daily Minutes	-.150	.047	.110	-.056	.027	.039	1.000			
8. Arch-related Pages	.091	.159	.087	.060	.123	.281*	.100	1.000		
9. The ratio of Arch-related Pages /All	-.008	.136	.028	.051	.093	.250*	-.032	.746**	1.000	
10. Pure Daily Time of Arch-related Use	.005	.164	.104	.007	.131	.286*	.419**	.753**	.841**	1.000

Note: * $p < 0.05$, ** $p < 0.01$.

4.1. The Relationship between Design Studio Performance and Creativity

By analyzing the correlations between the two variables of creativity and studio performance, a positive and significant relationship was obtained between the students' grades in the design course and the overall creativity score in TTCT ($r=0.352$, $p<0.01$). But the critical point here is that out of the four subcategories of creativity, only two sections, fluency, and originality, have positive and significant correlations with the studio's grade ($r=0.321$, $p<0.01$; $r=0410$, $p<0.01$). Therefore, the two indicators of elaboration and flexibility had no significant correlation with the students' grades and their design performance.

4.2. The Relationship between Design Studio Performance and Instagram Use of Architecture Students

Contrary to expectation, no correlation was found between the parameters of students' use of Instagram as a visual source influencing their design and their grade in the studio course. Therefore, the use of Instagram by architecture students of any quality doesn't correlate to their studio performance. Instagram cannot be named a tool among the effective parameters on that variable.

4.3. The Relationship between Creativity and Instagram Use of Architecture Students

The results were obtained by examining the correlations between the variables of architecture students' Instagram use and their creativity level. Of the four main parameters of the Instagram use variable, three parameters directly related to architecture were correlated to only one of the creativity subcategories. By investigating the use of Instagram, the parameters of "number of followed architecture-related pages", "the ratio of architecture-related pages on the total followings", as well as "the pure architecture-related time of Instagram use per day" had positive and significant correlations with the subcategory of flexibility on students' creativity measured by the Torrance Test of Creative Thinking ($r=0.281$, $p<0.05$; $r=0.250$, $p<0.05$; $r=0.286$, $p<0.05$). The results indicate that the overall score of creativity and the three subcategories of fluency, elaboration, and originality have no relationships with the Instagram use in architecture students who participate in the research.

5. DISCUSSION

5.1. Relationships among Design Studio Performance and Creativity

Initially, it was expected that considering the vital role of creativity in the design studio performance of students in the literature review and similar research papers, the overall score of creativity and all four subcategories would have positive and significant correlations with the grade of architecture students in the Design Studio III course. In the literature, results varied from no correlations to remarkable ones. In the first place, Alipour reported the internet as one of the items that connects architectural design and other parameters of the intuitive approach (Alipour, 2019). Cho reported no correlation between creativity and all the subcategories and design studio performance (Cho, 2017). But, Gajda, and Matthew and Stemler found different levels of correlation that the current study's findings comply with them (Gajda, 2016; Matthew & Stemler, 2013). On the other hand, parker

demonstrated all the elements of creativity concerning design studio performance (Paker Kahvecioğlu, 2007).

Among the found correlations, fluency and originality had positive and significant correlations with the studio performance. It was predictable that the originality would influence the students' grades because of the innovation and novelty integrated into the grades in similar studios. But, the fluency subcategory is associated with producing a large number of ideas. An optimized idea has a higher value than the high quantity of ideas in architecture, regardless of their quality and appropriateness. Thus, it seems that although the number of ideas produced in the fluency and the power to develop one of them are two separate topics, there is a hidden and internal connection between them that does not appear, but the impact of this relationship on the overall performance of students in the studio will be evident.

The two subcategories of elaboration and flexibility don't correlate with the design studio performance. Elaboration is about attention to detail, and flexibility considers all the dimensions of a problem. In architecture, both attention to details and the presence of multidimensional components together, such as beauty, function, structure, specific challenges of the designer, etc., are among the most valuable items in increasing the level of design. Therefore, it's surprising that there is no relationship with the students' studio performance in these two parameters. This problem is rooted in the studio assessment system's weakness, the difference in the nature of creativity and design studio performance, and the difference between intrinsic creativity and creativity that emerged in the design output.

First, only two course instructors will evaluate the designs and assess the projects with their grades at the end of the semester. This may decrease the possibility of errors, along with personal tastes and surrounding issues. Second, the problem lies in the essence of creativity related to the individual's attributive and personal matters. Still, the design studio's performance is education-oriented and based on student learning and hard work, in which creativity emerges alongside other items. For instance, other influential factors such as the method of presentation, personal skills, particular circumstances of the student during the studio period, possible personal problems, etc. can be mentioned in this area that according to the same patterns and natural differences between the two variables, their effect on the grades in the course are different from their impact on creativity. Finally, the point is about the difference between creativity in a person's nature and the creativity shown in their design. A person may get a high score on the creativity test, but changing the state of creativity from potential and intrinsic to actual as evidenced by design is not done correctly and successfully. This fact was also mentioned in Demirkan and Afacan's (2012) study in artifacts and the creativity that emerged in the design output (Demirkan & Afacan, 2012), while the Torrance test of creative thinking emphasizes on personal and innate creativity of individuals. Therefore, with these interpretations, the results obtained in the field of correlations between creativity test scores and the students' design studio performance can be justified and explained.

5.2. No Relationship between Design Studio Performance and Instagram Use of Architecture Students

Although 87.1% of the study participants rated the relationship of their design studio performance with their Instagram use as medium and higher, and 41.4% reported its effect on studio performance as high and very high, the results indicated that these two variables don't correlate with each other. From the perspective of new digital tools, Shakibamanesh pointed out the positive impact of electronic and virtual environments on the design process (Shakibamanesh, 2014) that the findings are on-aligned when it comes to social media in the nearly same situation.

Only a limited number of papers focused on these relationships by studying the literature. Most of the articles have highlighted the impact of using social media on studio performance consciously as an educational tool. No study was published related to the unconscious effect and integrated use of Instagram besides other virtual activities during the day.

Perhaps, the grades of the design course in the existing system's educational structure may not be a good indicator of the students' design studio performance, and many factors may reduce its accuracy. Another questionable point is the students' report on the number of architecture-related pages they follow on Instagram. Many architectural pages deal with other topics as well, and many architects have used Instagram as a diary, emphasizing everyday life instead of their designs. Therefore, there is no quantitatively accurate scale to accurately measure the number of architectural materials in each individual's feed. Also, in this research, the activity level of all pages, both architectural and non-architectural, is considered the same. While the pages may periodically, intermittently, and depending on specific circumstances, increase or decrease their

activity to find a particular bias towards various topics.

In addition to these issues, there is a lack of a valid framework for students' architectural use of Instagram that enhances their level of architecture learning. Suppose students follow the proper and accurate architecture sources according to this model. In that case, they will have a chance to learn more correct concepts than other students, and in this case, the results of the relationship between the two variables may be different.

5.3. Relationships among Creativity and Instagram Use of Architecture Students

It could be easily predicted that digital platforms support creativity despite the doubt beyond using them in design studio courses, and the study is aligned properly with the study of Heidari and Polatoğlu. (2018). The results of a wide range of studies on the direct correlation between social media use and improving creativity are in line with the current study results (Acar et al., 2019; Casaló et al., 2020; Malik et al., 2020; Salehudin et al., 2020). Of all the creativity parameters, only the flexibility subcategory had a positive and significant correlation with the three parameters of social media use: the number of followed architecture-related pages, the ratio between followed architecture-related profiles on all the following, and the pure daily time of architecture-related use of Instagram.

The reason for this result can be found in the definition of flexibility. The fact that a higher degree of shifting approaches leads to increased flexibility can be seen in creativity, and its link to Instagram use. While scrolling different images, people on Instagram immediately see various architectural and non-architectural contents in a row. This diversity of data and their perception by the user quickly results in enhanced flexibility.

Another noteworthy point is the lack of correlations between the three other subcategories of fluency, elaboration, and originality and the variable of Instagram use in the TTCT. The TTCT is a general test with an appropriate level of validity and reliability. But, it has a limited capacity to measure creativity related to architectural design itself. So, there's a need to develop a measurement tool that can assess all domain-specific design creativity criteria (Cho, 2017). Many creativity tests are related to general tasks and usually neglect domain-specific information (Cash & Snider, 2014). There is a gap in TTCT that may not demonstrate all the aspects of creativity in architecture students. The test has different items, but there's nothing related to architectural skills. So, all the factors that impress architectural design won't be measured in the TTCT (Cho, 2017). Therefore, all aspects of architecture-oriented creativity may not be shown in the present test and study. This problem expresses the need to make a separate test of creativity for the field of architecture and the introduction of its new subcategories. An example of this solution can be found in Demirkan and Afacan's (2012) study, whose tests and assessments were appropriate to a branch of design, and all related aspects were considered (Demirkan & Afacan, 2012). Therefore, the correlations can be defined correctly in a new architecture-related framework.

6. CONCLUSION

The use of visual social media has become a common phenomenon among architecture students, and this role in their academic and professional lives created a gap in the studies. As the literature demonstrates, there isn't any standard prescription for identifying the effects of social media on the design process and the design outcome of architects, and the findings alter significantly in different conditions.

This study investigated the relationships between three variables of creativity, design studio performance, and social media use among Tabriz Islamic Art University architecture students, Iran. A significant and positive correlation was observed between the grade of the design course and the overall score of creativity along with the fluency and originality subcategories measured by the TTCT. By analyzing the students' use of Instagram, it was concluded that this usage, although not related to the grade of their design course as the indicator of design studio performance, the parameters of its architectural-related use had a positive and significant correlation with the flexibility subcategories.

Indeed, the use of this social media has not affected the studio performance. Still, a high percentage of architecture students have acknowledged this relation and considered it an influential factor in their design studio performance. Therefore, there is a need to construct a new test that fits the architecture, unlike other general creativity tests like the TTCT. The test should be in line with the architectural design components, and its subcategories should cover all the talents and potentials in the field of architecture. After that, the evaluation system for the design studio course in Iran needs to be reviewed. The design studio course's grades must be presented in a new and codified

framework to get closer to its actual value. The distribution of various components in this new system must be improved.

Conscious or unconscious, architecture students perceive the architectural-related content of Instagram with different qualities. What Instagram shows them today is an essential and visually accessible resource that will lead them to the same resources and information in their professional life in the future. So, they will be the architects of how media is showing them now. Therefore, it is necessary to construct a correct and optimized model for the architecture students to use Instagram social media by decision-makers of Iran's architecture education system.

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HOW TO CITE THIS ARTICLE

Pourahmad Ghalejough, A., Hashempour, P., Haghparast, F. (2022). Creativity, Design Studio Performance, and Social Media: A Study of Instagram Use among Architecture Students. *Int. J. Architect. Eng. Urban Plan*, 32(2): 1-15, https://doi.org/10.22068/ijaup.528

URL: http://ijaup.iust.ac.ir