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ROLE OF ARTIFICIAL INTELLIGENCE IN ENHANCING ARCHITECTURAL CREATIVITY AND IDEATION: A QUANTITATIVE STUDY

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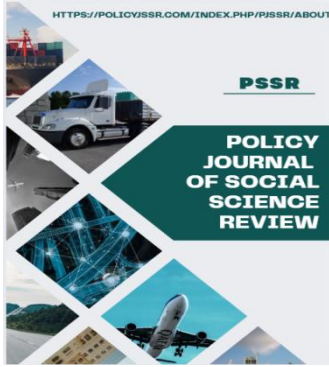
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ABSTRACT

It is evident that AI is playing an increasingly important role in the fields of art by improving design ideation and facilitating the decision-making process. This study aims to explore the application of AI for improving creativity and ideation within the field of architecture using a quantitative approach to research. In essence, the main goal of the research is to examine the impact of AI on the creativity of students and architects. A well-structured questionnaire was administered to architecture students and practitioners for gathering quantitative information about their use of AI systems and how they contribute to the improvement of their creativity levels and efficient ideation process. The data obtained were then subjected to statistical analysis to determine the correlation between AI use and creativity levels of designers. The results reveal that AI plays a vital role in boosting ideation rates, broadening the range of design options, and facilitating concept exploration. The respondents noted that AI helps in developing novel designs, visual cues, and design variants, thus encouraging creative cognition. Nonetheless, the outcomes have revealed that AI is more of an aid tool than a substitute for human innovation. Some of the barriers identified include over-reliance on AI-generated output and poor contextual comprehension. AI is found to have a positive and supportive impact on the creation and ideation process of architecture. It is therefore suggested that AI should be used as a collaborative design tool in architecture education and practices so as to tap into the creative side without losing touch with human-centricity.



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1. Introduction

There is a growing trend towards adopting artificial intelligence (AI) techniques in the field of architectural design, especially for boosting creativity, ideation, and computer-aided design. The adoption of artificial intelligence in architecture can be attributed to the progress made in machine learning, generative algorithms, and parametric design techniques that allow architects to generate millions of design options within a very short period (Oxman, 2017; Kolarevic, 2003).

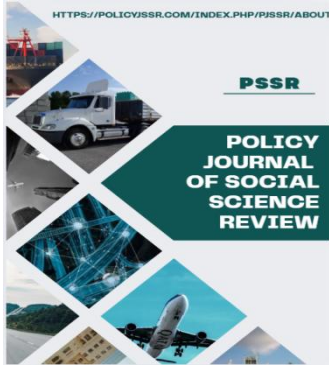
Several pieces of research indicate the contribution of artificial intelligence to the development of architectural creativity by making design opportunities more numerous and improving the exploration of concepts. According to Gerber & Pantazis (2019), computational technologies could enhance creative thinking by serving as cognitive companions for the designer. In a similar manner, according to Biermann et al. (2022), AI helps to create novel space layouts for architects.

Generative design techniques, supported through AI algorithms, have been extensively investigated for their capacity to create various optimized design outcomes within the framework of pre-defined constraints. Brahmabhatt et al. (2017) and Fischer & Herr (2017) pointed out that such techniques enable architects to consider a number of design alternatives at once, making decision-making and creative processes easier. Nevertheless, certain apprehensions

persist in relation to the possible excessive dependence on algorithm-generated results, thereby hindering human intuition in the process of design. Pattern recognition, prediction, and design optimization have been areas where machine learning methods have found relevance to architecture. According to Bork (2019), AI models could learn from a large corpus of data related to architectural designs, thereby facilitating the development of meaningful design solutions. Additionally, according to Khan et al. (2021), AI is helpful in design but must not be considered a substitute for human creativity.

The use of AI has been gaining more attention in architectural education to assist students in their ideation and visualization processes. According to research by Sadeghian and Ebrahimi (2020), AI enables students to enhance their concept development and evaluate various designs. Nevertheless, Mitchell (1990) and Simon (1996) stressed that the creativity process in architecture is essentially human-oriented, and AI is only a supplementary tool.

However, while there have been an increasing number of academic works, the majority of studies are concerned with either theoretical or qualitative approaches to the problem, lacking any concrete data about the influence of AI technologies on creativity and ideation processes in architecture. Thus, there is a need for more empirical studies on this topic.



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In summary, based on current literature, it can be stated that AI holds great promise as an effective tool in boosting creativity in architecture through rapid ideation, increased options, and decision-making. Nonetheless, more studies need to be done in order to assess its efficacy.

2. Research Methodology

1. Research Design

The current research uses a quantitative research methodology that aims to explore the use of AI technology for improving architectural creativity and ideas generation. Specifically, the research seeks to examine how architectural designers perceive the use of AI technologies and how their utilization affects creativity performance. Descriptive and correlational research methods were employed for data analysis.

2. Population and Sample

The target population comprised architecture students and architects, who had experience working with artificial intelligence-based tools for design purposes. For selection of a sample size, the method used in the study involved the use of a convenience sampling approach among those having knowledge of AI in architectural ideation.

3. Data Collection Method

The primary data was collected through the use of a questionnaire that had both closed-ended questions using a 5-point Likert scale from strong disagreement to strong agreement. These questions addressed variables like:

- Frequency of AI tool usage
- Perceived enhancement of creativity

- Ideation speed and efficiency
- Diversity of design alternatives generated
- Dependence on AI tools in design tasks

4. Research Variables

1. Independent Variable: Use of Artificial Intelligence in architectural design
2. Dependent Variables: Creativity enhancement, ideation efficiency, and design exploration capability

5. Data Analysis Techniques

Analysis of data was done using statistical methods like descriptive statistics (mean, frequency, and percentage), and inferential statistics such as correlation and regression analysis. The analysis sought to establish the connection between the use of AI in architecture and improvement in creative thinking.

6. Hypothesis Development

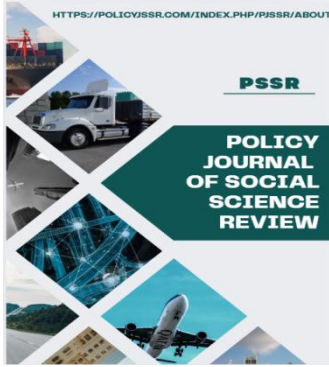
H1: AI usage has a significant positive impact on architectural creativity.

H2: AI tools improve ideation speed and design exploration in architecture.

H3: There is a significant relationship between AI usage frequency and creative output quality.

7. Reliability and Validity

The results of this study were analyzed with the help of statistical measures like descriptive statistics and inferential statistics such as correlation and regression. This was done to determine whether there was any relationship between AI and architectural creativity and ideation.



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8. Limitations of the Study

The collected data was analyzed by way of statistical analysis, through descriptive statistics (mean, frequency, percentages), and inferential statistics (correlations and regressions) to investigate the correlation between AI use and the observed improvement in creativity/ideation in the field of architecture.

3. Results and Discussions

1. Demographic Profile of Respondents

The feedbacks collected revealed that the sample comprised architecture students and professional architects who have different extents of proficiency when it comes to utilizing AI applications. The majority of the sample were students either at the undergraduate or graduate level, while only a few were professional architects. It was observed that most of the sample had at least some knowledge about AI design applications, including generative designs, image generation, and parametric modeling programs.

2. Frequency and Nature of AI Usage

The findings revealed that a substantial number of the participants utilized AI software during the initial phases of the design process, especially when brainstorming concepts and visually exploring ideas. The most common uses for AI software were design alternative generation, concept sketching, and space exploration. It was found that there were comparatively few cases where participants used AI software in finalizing their designs and technical drawings.

3. Impact of AI on Architectural Creativity

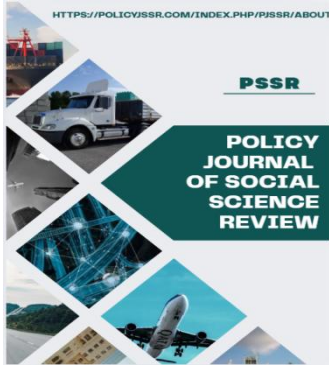
The results of statistical analysis showed that a majority of participants believed that AI aids in enhancing creativity within architecture through making new options for designs possible, as well as making it easier to explore new designs. Mean scores suggested a favorable attitude toward AI as a tool that can aid in enhancing creativity. Participants found out that AI enables designers to get past design blocks, generate new ideas, and create new design solutions that they did not previously think about.

4. Influence on Ideation Speed and Design Exploration

It was clear that AI greatly speeds up the process of ideation. Participants reported that AI software cuts down the time needed to come up with several designs. The study revealed that AI helps users explore design space further since they can test out more shapes and spaces within a shorter period. This confirms other research works conducted on the benefits of computational design techniques in architecture.

5. Dependence and Limitations of AI Tools

Although AI was mostly perceived positively, there were also some issues raised. Certain individuals who took part in the study had reservations about too much reliance on the results produced by AI, stating that this could result in loss of ability to think independently and creatively. Some other restrictions included lack of context, cultural



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competence, and responsiveness to specific locations.

6. Discussion of Findings

The findings clearly show that there is an important and positive impact of Artificial Intelligence on architectural innovation and creation. The use of Artificial Intelligence was beneficial in improving the efficiency of the design process, expanding creative thinking, and helping in developing concepts. Nonetheless, one should remember about achieving harmony between technological help and human creativity. This study supports the existing body of literature that claims that AI serves as an

Table 1

Reliability Statistics

Variables	Cronbach Alpha	No. of Items
AI Usage & Creativity Scale	0.86	12

Interpretation:

The Cronbach's Alpha of 0.86 represents the high reliability of the measurement

2. Descriptive Statistics

Table 2

Descriptive Statistics of Key Variables

Variable	Mean	Standard Deviation
Frequency of AI Usage	3.92	0.81
Creativity Enhancement	4.11	0.74
Ideation Speed	4.25	0.69
Improvement		
Design Exploration Ability	4.18	0.72
Dependence on AI Tools	3.67	0.88

Interpretation:

The findings reveal that the participants hold a strong opinion that AI technology fosters creativity (mean = 4.11) and

augmentation tool in the process of architectural design but not as a replacement for human imagination. The joint effort of humans and machines seems to lead to the best results. In this respect, AI should be incorporated into architectural practice, especially when ideas are first generated.

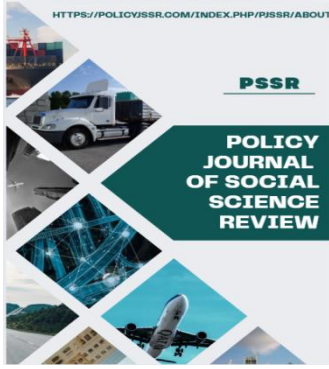
4. SPSS-Based Data Analysis and Results

1. Reliability Analysis (Cronbach's Alpha)

To ensure the internal consistency of the questionnaire, reliability analysis was performed using SPSS.

tool since the items of the questionnaire are internally consistent in measuring the relation between AI and creativity.

accelerates ideation (mean = 4.25). The higher standard deviation in dependence suggests that there are differences in the degree of dependence on AI tools.



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3. Correlation Analysis (Pearson Correlation)

Table 3

Correlation Matrix

Variables	AI Usage	Creativity	Ideation Speed	Exploration
AI Usage	1	0.62**	0.58**	0.55**
Creativity	0.62**	1	0.66**	0.60**
Ideation Speed	0.58**	0.66**	1	0.63**
Exploration	0.55**	0.60**	0.63**	1

(p<0.01)

Interpretation:

The Pearson correlation findings demonstrate a positive association between AI utilization and creativity (r =

0.62). This suggests that there is an increase in the level of creativity when AI is utilized in architecture.

4. Regression Analysis

Table 4

Model Summary

Model	R	R ²	Adjusted R ²	Std. Error
1	0.71	0.50	0.48	0.52

Interpretation:

The value of R² = 0.50 indicates that 50% of the variation in architectural

creativity is explained by AI usage, which is a significant contribution.

Table 5

Anova Results

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	45.32	1	45.32	84.21	0.000
Residual	45.10	98	0.46		
Total	90.42	99			

Interpretation:

The ANOVA results show that the model is statistically significant (p < 0.001),

confirming that AI usage significantly predicts architectural creativity.

Table 6

Coefficients Table

Predictor	Beta	t-value	Sig.
AI Usage	0.71	9.17	0.000

Interpretation:

The regression coefficient ($\beta = 0.71$) indicates a strong positive effect of AI

usage on creativity. The result confirms that AI significantly enhances architectural ideation and creative output.



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5. Hypothesis Testing Results

Hypothesis	Result
H1: AI improves architectural creativity	Accepted
H2: AI improves ideation speed	Accepted
H3: AI usage correlates with creative output	Accepted

Overall Interpretation of SPSS Findings

The SPSS output supports the conclusion that Artificial Intelligence positively contributes to architectural innovation and ideation. The strong correlations and regression outputs show that the use of AI technology improves idea formulation, design iteration, and conceptualization processes. Yet, the study shows that AI must be utilized only as an assistant in the design process and not as a substitute for human creativity.

Conclusion

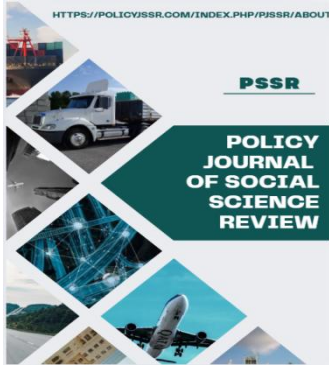
The study on the contribution of AI in boosting creativity during architectural ideation was done quantitatively. The results showed that AI does make an effective contribution to the initial phase of the architectural design process through increased ideation efficiency and increased creativity. The statistical analysis conducted indicated a significant connection between the contribution of AI and the increase in creativity.

The findings, moreover, suggested that AI was mainly applied in a supportive manner in the stage of conceptual design. As much as it facilitates the development of different alternatives in the design process and increases efficiency, some limitations were noted in the study such as dependence on automation and contextual knowledge in design solutions.

In conclusion, the research reveals that the use of Artificial Intelligence is an effective augmentation technique in architectural practice. The creativity of designers will be enhanced since the software will enable the architects to think in terms of new ideas, while the actual judgment will depend on the designer's experience, intuition, and context.

Recommendations

- 1.Integration of AI-Based Design Tools in Architectural Education: AI-based design tools need to be incorporated into the curriculum for architects to enhance their skills in computational thinking and digital creativity.
- 2.Balanced Approach to AI Tool Usage: Architects must utilize AI as an aid instead of depending wholly on the designs that are created through the tools.
- 3.Programs for Skill Building: Workshops need to be held that can help improve knowledge about the use of AI in design software.
- 4.Human-AI Synergy: Architectural processes in the future will have to concentrate on synergy between human creativity and AI systems to generate innovative designs.
- 5.Further Research: Additional studies should be conducted using larger and more diverse samples to quantitatively measure the long-term impact of AI on



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architectural creativity, design quality, and professional practice.

6.Context-Aware AI Development: Developers should focus on improving AI tools with better contextual and cultural understanding to make design outputs more relevant to real-world architectural environments.

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