Pixel Art and Its Influence on User Interface Creativity: A Design Perspective

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***Abstract*— This research explores the impact of Pixel Art games on the creativity and User Interface (UI) design skills of college students, assessing whether exposure to this gaming format can enhance design performance. Pixel Art games, known for their minimalist graphical style, are recognized for stimulating creativity, but their direct influence on UI design is less understood. The study involved two groups: one that played Pixel Art games before engaging in UI design tasks and a control group that did not. The research assessed their performance across five key UI design criteria: Layout, Color Scheme, Button and Font Clarity, Usability, and Creativity. Statistical analysis revealed that the Pixel Art group scored significantly higher in Layout (8.19 vs. 6.12), Usability (8.43 vs. 6.26), and Creativity (8.36 vs. 6.53), This study used Group Difference Testing t-tests to evaluate the impact of playing a pixel art game on students' UI design skills. These findings suggest that integrating Pixel Art games into design education could foster creativity and improve key design skills, contributing to more engaging learning experiences in art and design.**

Keywords*— *pixel art, user interface, creativity, game-based learning, design education

I. INTRODUCTION

The User Interface (UI) design of a mobile application plays an important role in creating a good user experience. Effective UI design in education is achieved by balancing cognitive load with students' capacity to absorb information. A user-friendly interface with manageable cognitive load enhances learning and visual communication outcomes. [1] . Good UI design takes into account many factors such as beauty, ease of use, and consistency in design and the ability to respond to user needs. However, developing creativity and UI design skills is a challenging process. Especially in an era where competition in the mobile application industry is becoming more intense. Finding methods and tools that can help you develop your UI design skills effectively is therefore very important.

Today, various methods have been proposed to promote and develop the creativity of designers. One of them is using games as a tool to stimulate creativity and practice design skills. Pixel art continues to hold significance, offering valuable examples through advancements in technology. Its use in the digital world and various other fields highlights the nostalgic appeal of pixel art. [2]. Pixel art, as a distinctive art style, intentionally limits images to a specific resolution. The use of dithering patterns adds a bold and expressive quality, encouraging aspiring character and new media designers to experiment creatively. Its uniqueness as an art form motivates artists to continue using it as a powerful tool. [3] However, the use of pixel art in UI design. It is still a matter that needs further study. This is because these types of graphics can affect a designer's creativity and UI design performance.

The world of video games offers a powerful opportunity to harness their potential for educational purposes. By focusing on knowledge that traditionally causes students stress and uncertainty, video games can provide a more engaging and less intimidating learning experience. [4]. Playing video games can enhance certain aspects of creativity, particularly flexibility, which is the ability to adapt one's thinking and generate diverse ideas. In a study involving different game genres, including sandbox and puzzle games, it was found that participants exhibited increased flexibility after gameplay, while other creative measures like fluency and originality showed little change .[5] The simplicity of the pixel grid makes pixel art relatable and accessible, supported by the limitations set by the pixel art community. It emphasizes color conservation and composition, skills valuable in other art forms. While easy to start, mastering pixel art requires experience, reflection, and an understanding of the tools and techniques to adapt and work within its limitations. [6] Designers may be inspired and develop their skills designed in a way that is different from traditional learning from pixel art.

This research focuses on the impact of playing games in the form of pixel art on the UI design of mobile applications in college students. The aim is to analyze how games with pixel art graphics influence the creativity and efficiency of young designers' UI designs. This study also helps to enhance understanding of the use of games as a tool for developing design skills and propose new approaches to the application of educational games in the fields of art and design. This research will explore and analyze how exposure to pixel art graphics through gameplay affects students' UI designs. And how will the results be useful for developing teaching methods and practicing UI design skills in the future.

II. Research Objective

1) To study and analyze the relationship between playing games with pixel art graphics and the results in UI design of students studying in the field of Computer Graphics and Multimedia.

2) To summarize the impact of design work from students who received experience with pixel art graphics that affects UI design work.

III. Analysis of the relationship between Pixel art graphics and UI design.

TABLE I. Analysis relation of Design Principles in Pixel Art and UI Design

Topic	Pixel art design	UI design	Connection
Color Usage	Focus on using limited colors. To create a clear and outstanding image	Use colors to highlight different parts of the UI so it's clear and intuitive.	Color in pixel art is similar to UI design, where elements are clearly defined and highlighted to increase usability.[1]
Simplicity	The format is simple and easy to understand. Due to technical limitations	The UI design should be simple so that it is easy for users to understand and use.	Both pixel art and UI emphasize simplicity in presenting information so that users can easily understand and use it
Arrangement of elements (Layout)	Effective positioning of images in confined spaces.	The UI layout must be orderly and natural to use.	Elements in Pixel Art and UI emphasizes efficiency in use. Taking into account the size and position of various elements
Communicating feelings (Expressiveness)	Uses minimal details but manages to communicate the mood and atmosphere of the game well.	The UI should communicate a feel and atmosphere appropriate to the content of the application.	Pixel Art uses simple but clear images to communicate. This is similar to UI design that aims to communicate feelings to users [7]
Familiarity	Create a familiar and retro feel from past games.	A good UI should be designed to be familiar to users and easy to learn.	Patterns in pixel art can be used in UI design to enhance the user experience [7]

Fig. 1. Relation of design and princliples between pixel art design and UI design.

Table shows design principles between pixel art and UI design, emphasizing their use of visual elements to enhance user interaction. Both fields employ limited color palettes to highlight key features, ensuring clarity and usability. Simplicity is central, with both pixel art's straightforward format and UI design's accessible layouts making information easily understandable. Layouts in both are efficiently organized to optimize space and improve user experience. Additionally, both aim to evoke specific feelings with minimalistic yet expressive details, and they utilize familiar visual patterns to make their designs intuitive and easy to learn, enhancing the overall user experience.

IV. Literature Review

The thesis titled "Creativity support in games for motivated learning" [8] explores the integration of explicit creativity support within serious games, particularly aimed at enhancing motivated learning in adult professional settings. It highlights the growing importance of serious games in fostering creative problem-solving skills, yet notes that many existing games do not effectively utilize available creativity techniques and tools. The research introduces a framework for designing creative serious games, validated through formative and summative evaluations of prototype games designed to train carers in person-centred care for individuals with dementia. The findings indicate that these creative serious games can significantly enhance the acquisition of creativity skills, generate positive learning outcomes, and improve motivation among players. The thesis not only provides a proof-of-concept for the effectiveness of creative serious games but also suggests that the developed framework could be applicable across various domains, thereby broadening the impact of creativity support in serious gaming.

A Reflective Game Design framework for Game-Based Learning. [9]The paper discusses the integration of reflective practices into game-based learning (GBL) frameworks, highlighting the limited use of active reflection methods in existing models. The authors propose a Reflective Game Design (RGD) framework that emphasizes iterative learning through reflective observation and authentic feedback, aiming to enhance the learning process by embedding reflective elements at each stage of game design. Overall, the literature indicates a significant opportunity for enhancing GBL through reflective practices, yet emphasizes the necessity for a structured approach to effectively implement these practices in game design. The paper also notes the need for a comprehensive evaluation framework in GBL, referencing the LEAGUE framework which categorizes GBL elements into six core dimensions, thus providing a theoretical guide for designers and researchers.

The article A Game-Based Learning Approach in Digital Design Course to Enhance Students' Competency [10] emphasizes the significant impact of game design on educational outcomes, particularly in enhancing student motivation and engagement. By integrating gamification into the curriculum, the study found that students showed a strong preference for the use of digital games, with 92.9% in 2017 and 83.3% in 2018 expressing interest in more game-based learning tools. The implementation of a holistic online environment, grounded in Keller's ARCS model and Malone's motivational model, facilitated active learning and self-management, leading to improved attention, relevance,

confidence, and satisfaction among students. Additionally, the use of project-based learning through game development, such as creating a digital version of Tic-Tac-Toe, fostered creativity and problem-solving skills, demonstrating that well-designed educational games can significantly enhance the learning experience and outcomes for students. The impact of game design on student learning is significant, particularly in enhancing creativity and engagement. In the study, it was found that when 5th and 6th grade students participated in designing their own educational games, there was a statistically significant improvement in their creative thinking skills, as measured by the Torrance Test of Creativity. The research indicated that the game design process not only served as a fun and engaging activity but also fostered a creative thinking environment, allowing students to express their ideas and innovations effectively.

Additionally, students reported that the game design course provided a pleasant and entertaining learning atmosphere, which differed from traditional didactic teaching methods. This shift in learning approach encouraged students to be more involved and motivated in their educational journey.[11]

Overall, integrating game design into the curriculum can be a constructive step towards enhancing students' creativity and preparing them for a technology-driven future.

The paper Creative Game Design Training Requirements [12] explores the critical role of creativity in game design, noting that many games fail due to a lack of innovative ideas and structured creativity training in educational programs. Through document analysis and expert interviews, the authors identify essential components for fostering creativity, such as intelligence, motivation, and experience. They propose a systematic training model that integrates technology support and community engagement, validated by a high Inter-Rater Reliability (IRR) score of 0.90 from experts. This research provides a framework for educational institutions to enhance creativity training, ultimately aiming to improve the quality of games produced in the industry.

V. Research Methodology

[13] *Establishment of an experimental group and a control group*

The preliminary selection of participants for this study involved 90 individuals, divided into two groups of 45 participants each. The initial criteria for selecting and dividing participants was based on their responses regarding their experience with playing games that feature Pixel Art design and graphics. If participants had frequent experience playing such games, they were assigned to Group 1. Participants in Group 2 consisted of those who had little to no experience with games featuring Pixel Art design.

- Group 1 45 students (Experimental Group): students played a Pixel Art game for 2 hours before designing the UI.
- Group 2 45 students (Control Group): Students designed the UI without playing games before taking the test.

B. Providing time and tools for design

Both groups received the same 3 hours of UI design time and were given the same design questions. Design tools included Figma, Adobe Illustrator, and Adobe Photoshop.

C. Design evaluation

Each project is graded independently with the following criteria: Layout, Color Scheme, Button and Font Clarity, Usability, and Creativity. Student designs in each group will be evaluated and a score recorded.

The evaluation and scoring of the User Interface design projects in this study, the assessors consist of 3 instructors from courses related to Computer Graphic and Multimedia design.

For the evaluation of the UI design in this study, the scoring criteria and guidelines are outlined in the following table.

TABLE II. SCORING CRITERIA AND GUIDELINES

Criteria	Score	Description
Layout	1-2	Disorganized layout, confusing to navigate.
	3-4	Some structure, but cluttered and disorganized, affecting flow.
	5-6	Moderately clear layout, minor inconsistencies.
	7-8	Well-organized layout with minor issues.
	9-10	Highly intuitive and organized layout, seamless navigation.
Color Scheme	1-2	Clashing colors, poor readability.
	3-4	Some harmonious colors, but major contrast issues.
	5-6	Functional color use, but lacks polish; minor readability issues.
	7-8	Well-coordinated color scheme with few balance issues.
	9-10	Perfectly balanced colors that enhance readability and clarity.
Button & Font Clarity	1-2	Illegible buttons or fonts, difficult to read.
	3-4	Some readable buttons and fonts, but size or color impacts readability.
	5-6	Generally clear, but size or contrast could be improved.
	7-8	Clear and readable with only minor adjustments needed.
	9-10	Highly readable and well-sized buttons and fonts, easy to interact with.
Usability	1-2	Confusing navigation, major usability issues.
	3-4	Poor usability, unclear navigation.
	5-6	Functional usability, but navigation needs improvement.
	7-8	Mostly clear navigation and usable, minor issues present.
	9-10	Intuitive navigation, highly usable, no major issues.
Creativity	1-2	Lacks creativity, basic and uninspired design.
	3-4	Some creative elements, but overall conventional.
	5-6	Moderate creativity, does not stand out.
	7-8	Creative with unique ideas, room for improvement.
	9-10	Highly creative, innovative design with original ideas.

Fig. 2. The table presents the guidelines and criteria for scoring the UI design in each aspect, based on the images provided by the test participants.

Table 2 presents the guidelines for scoring the UI design in each aspect, with detailed descriptions and specifications

for the scoring criteria in each category. The table outlines the score ranges for each level, providing a framework for the evaluators to assess the design based on various criteria.

D. Collection and analysis of desvriptive data (Descriptive analysis)

Data obtained from the assessment will be analyzed descriptively. That includes Mean, Standard Deviation, Min and Max to understand the distribution pattern and average of scores in each of the 2 categories.

E. Group differnce testing

This analysis will be performed using the t-test statistical technique to test for differences in scores between the two groups.

F. Summary of result

Analysis and conclusions from the data obtained to disseminate the results and findings of the study.

Fig. 3. Students in group 1 playing the basic pixel art game style before beginning design application UI.

VI. Data Analysis

From the score data of both groups that were collected by the entire group of students who experimented both the group that tried playing the Pixel Art game before starting to design the UI and the group that did not try playing the Pixel Art game before starting to design. The researcher collected scores and used them to analyze the data. Descriptive Analysis with analytical data as follows.

A. Mean

Formula for calculating Mean

$$\text{Mean} = \frac{\sum_{i=1}^{n} x_i}{n}$$

x_i= Each score in the data set

n= Total amount of data

B. Standard deviation (S.D.)

$$\text{Standard Deviation} = \sqrt{\frac{\sum_{i=1}^{n}(x_1 + Mean)^2}{n-1}}$$

C. Minimum value (Min) and maximum value (Max)

These values indicate the extent of the data where the lowest value is the smallest score in the data set and the highest value is the highest score.

The results from the evaluation of both groups can be summarized according to this table.

TABLE III. Result of evaluation between group 1 and group 2

Topic of the assessed score	Group	Mean	S.D.	Min.	Max.
Layout	1	8.19	1.52	4.17	10.00
	2	6.12	1.27	3.40	8.74
Color Scheme	1	6.69	1.32	4.41	9.84
	2	7.06	1.60	2.84	10.00
Button and Font Clarity	1	7.55	1.46	4.98	9.92
	2	6.62	1.40	3.01	10.00
Usability	1	8.43	1.05	6.65	10.00
	2	6.26	1.42	3.12	8.97
Creativity	1	8.36	1.07	5.83	10.00
	2	6.53	1.38	2.39	9.1

Fig. 4. Evaluation score both group include Mean,S.D.,Minnimum and Maximum score .

D. Group difference testing

Group Difference Testing t-tests are an important part of statistical data analysis used in research to test for differences in results from a treatment or intervention among different groups. existing in the study. This test is especially important when researchers want to know whether a certain measure or intervention has a statistically significantly different effect between experimental groups. In the case of this study, analysis was used to examine the impact of playing a pixel art game on UI design by students.

Results from the t - tests for each assessment category are as follows:

Layout: t=7.014,p<0.001

t=7.014,p<0.001 - There were significant statistical differences between the groups with the gaming group having higher scores.

Color Scheme: t=−1.19,p=0.237

t=−1.19,p=0.237 - There were no significant statistical differences between the groups.

Button and Font Clarity: t=3.068,p=0.003

t=3.068,p=0.003 - There was a significant statistical difference with the gaming group having higher scores.

Usability: t=8.273,p<0.001

t=8.273,p<0.001 - There were significant statistical differences between the groups with the gaming group having higher scores.

Creativity: t=7.038,p<0.001

t=7.038,p<0.001 - There were significant statistical differences between the groups with the gaming group having higher scores.

VII. Data Analysis

Analysis of Mean, Standard Deviation, Min and Max. Analysis of Mean, Standard Deviation, Min and Max.
The results of collecting data were analyzed in each topic that was evaluated and the results were analyzed separately in each topic that was evaluated.

Layout: The Pixel Art group had an average score of 8.19 which was higher than the I did not play the game before designing it with a significant mean score of 6.12. The S.D. were 1.52 and 1.27, respectively, reflecting that the group with more experience playing pixel art games may have more creativity and structural planning.

Color Scheme: the group that played the Pixel Art game had a slightly lower average score of 6.69 compared to the group. The game was not played before designing with a score of 7.06, which may indicate that gameplay did not have much of an impact on color decisions.

Button and Font Clarity: the average score of the group that played the Pixel Art game was 7.55, which was higher than the group. I did not play the game before designing it with an average score of 6.62, it may indicate the ability to distinguish and clarify the design influenced by unique game graphics.

Usability: the gaming group had an average score of 8.43, higher than the non-gaming group's average score of 6.26. This difference may indicate that students from the pixel art group had improved their understanding of usability better UI through game interaction.

Creativity: the highest average score for the Pixel Art group was 8.36, compared to 6.53 in the no game group, indicating that having experience with pixel art games before starting the design process can stimulate creativity in UI design.

In this study, descriptive analysis results showed differences between groups of students who played the Pixel Art game before designing with groups that did not play the game in many evaluation categories. In particular, the average score for Layout in the Pixel Art group was 8.19, higher than the group who did not play the game before designing with a mean of 6.12, which is a statistically significant difference ($p < 0.001$) according to the t-test results found $t = 7.014$ in the category of Usability and Creativity. Significant statistical differences were also found with the group that tried playing the pixel art game having average scores for usability and creativity of 8.43 and 8.36, respectively, higher than the group's average score. The scores for Color Scheme and Button and Font Clarity did not show a significant difference, statistically significant at the same level especially in the Color Scheme category with values of $t = -1.19$ and $p = 0.237$, indicating that playing the pixel art game may not have a clear influence on the decision to choose and manipulate colors.

Group 1

Group 2

Fig. 5. Example UI design from student in Group 1 and Group 2.

VIII. Conclusion

This study examined the impact of playing pixel art games on UI design by dividing students into two groups: those who played the game and those who did not. The analysis found that the gaming group had significantly higher average scores in the layout, usability, and creativity categories with these scores reflecting increases in design skills covering layout and design. Effective use as well as increased creativity while the Color Scheme and Button and Font Clarity categories did not show significant differences. This indicates that these skills may require specialized practice and expertise that is not directly influenced by playing Pixel Art games.

This study found that playing pixel art games before designing a UI had a significant impact on scores in several evaluation categories, especially layout, usability, and creativity, where the differences were statistically significant. In terms of design, layout is important to create a good user experience and good interaction. Playing the Pixel Art game may encourage students to think about the placement and structure of various elements. On a deeper level previous research has shown that the use of pixel art has a different impact on users in terms of creating a different visual experience. The pixel art style significantly impacts players' design skills and learning by fostering creativity and problem-solving abilities. Engaging with pixel art encourages players to understand composition, color theory, and pixel placement, enhancing their overall design skills. The limitations inherent in pixel art challenge players to think critically and creatively, leading to innovative solutions in their own graphic designs. Additionally, exposure to pixel art provides insights into the relationship between abstraction and realism, enriching players' understanding of visual aesthetics and the historical context of design evolution in the gaming industry.[1]. The results from this study are

consistent with data from previous studies and reinforce this theory with significantly higher scores per this study. In the topic of evaluating usability and creativity, the game playing group also showed a statistically significant difference. Playing Pixel Art games that challenge students to think creatively to solve problems and present highly detailed graphics can increase their ability to design responsive and attractive UIs. Usability and Creativity among the gaming group also showed differences. Statistically important differences as well. Playing Pixel Art games that challenge students to think creatively to solve problems and present detailed graphics can increase their ability to design more responsive and engaging UIs.

The Color Scheme and Button and Font Clarity categories did not show significant differences. This indicates that these skills may require specialized practice and expertise that is not directly influenced by playing Pixel Art games. This study points to the possibility of using graphics games to enhance design skills in the educational context.

The results suggest that playing games that emphasize graphics and structure may improve the ability to deal with principles of art and design, such as pattern formation, understanding color, and generating innovative ideas in a game. Solving design problems. Implementing it in the classroom or in design workshops may help students see new ideas and can be applied without limits. This can lead to the creation of higher quality and more interesting work. Additionally, the results of this research provide an opportunity for researchers to further study the impact of game technology on developing other educational skills, making teaching and learning more effective and inclusive.

IX. Future Research and Development

Pixel Art, with its minimalist and retro aesthetic, provides a valuable tool for enhancing creativity and design skills, particularly in the realm of UI development. The research demonstrates that exposure to Pixel Art games significantly improves design aspects such as layout, usability, and creativity by encouraging designers to think critically within visual and structural limitations. Incorporating Pixel Art into design education and research can foster innovative thinking, enhance problem-solving abilities, and provide a unique perspective on visual composition, color usage, and the arrangement of elements. This makes Pixel Art a compelling subject for further academic exploration, particularly in developing new methods for teaching design principles and integrating game-based learning to stimulate creativity. Additionally, it offers practical applications in modern graphic design, where designers can draw on Pixel Art's emphasis on simplicity and clarity to create more intuitive and engaging user interfaces.

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