International Journal of Contemporary Issues in Social Sciences
Volume 3, Issue 2, 2024 ISSN(P):2959-3808 | 2959-2461

INTEGRATING GAMIFICATION STRATEGIES WITH VR/AR: ANALYZING THE RESULT OF EXPERIMENTAL ARCHITECTURAL STUDIO IN PAKISTAN

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Received: May 10, 2024 **Revised:** June 10, 2024 **Accepted:** June 25, 2024 **Published:** June 30, 2024

ABSTRACT

This study reflects upon integrating Gamification in Architecture using Virtual and Augmented reality (VR/AR) through studio pedagogy in Pakistan. It emphasizes the role of gamification in addressing the challenges of contemporary studio teaching, which needs to be updated with interactive and participatory design techniques. Game-based learning effectively incorporates spatial awareness, immersive interaction, and a collaborative environment that aligns with contemporary architectural studio requirements. The study highlights the outcomes of two studio projects from the Fall semester of 2023 conducted with 4th-year students from the Architecture Department at the University of Engineering and Technology Lahore: one involves redesigning Lahore's Liberty Market into a car-free zone, and the other simulates an alteration between a dystopian landscape and a solar-powered utopia to influence design choices. These projects are crucial for understanding the role of gamification in Architecture. The main challenges during the fourteen-week-long studio included the steep learning curve associated with new tools and technologies, including using Unreal Engine, a gaming software. Even with these hurdles, the research shows gamification as a promising approach for the future of architectural education. It posits that incorporating gamified VR/AR can significantly enrich the curriculum. The exploration led to the development of a robust design and collaboration skills essential for adapting to the changing architectural environment. The research paper suggests that cross-reality gamification has the potential to impact academic practices and, subsequently, the wider architectural profession, promoting a more involved, technologically adept, and environmentally conscientious approach to design.

Key Words: Gamification, Participatory Design, Student Engagement, Digital Architecture, Architectural Education, Virtual Reality.

INTRODUCTION

This research is a project or part of an ongoing Ph.D. research on Transitioning Architecture Studio Pedagogy in Pakistan. The central idea of the thesis is to investigate the impact of CAAD (Computer et al.) and other digital domains on Architecture learning in the studio, of Gamification techniques that are transforming pedagogic teaching and learning. This new approach has also opened a new dimension for Architectural education. Salama (1995) considers studios and classrooms as dynamic work and learning spaces that play a crucial role in shaping the social, cultural, and political relations that reflect real-life conditions. Giroux (2001) and Salama (2017) emphasize that transformative pedagogy should be an ongoing reflective and collaborative process. Schnabel et al. (2014) highlight how gamification can facilitate deep learning in architectural education. In line with other researchers, Porreca et al. (2020) highlight virtual environments' capacity to bridge the gap between theoretical knowledge and practical urban planning skills. The new

transformative XR gamification approach provides an ideal medium for training students for real-life situations and making them critical thinkers.

Although integrating gamification with VR/AR in education has great potential, Ponce Lara (2017) notes that in regions like Ecuador, a lack of recognition exists for the educational benefits of gaming. Similarly, Pakistan, a developing country, still has not recognized the potential of gamification and VR/AR in architectural education. To the best of the authors'

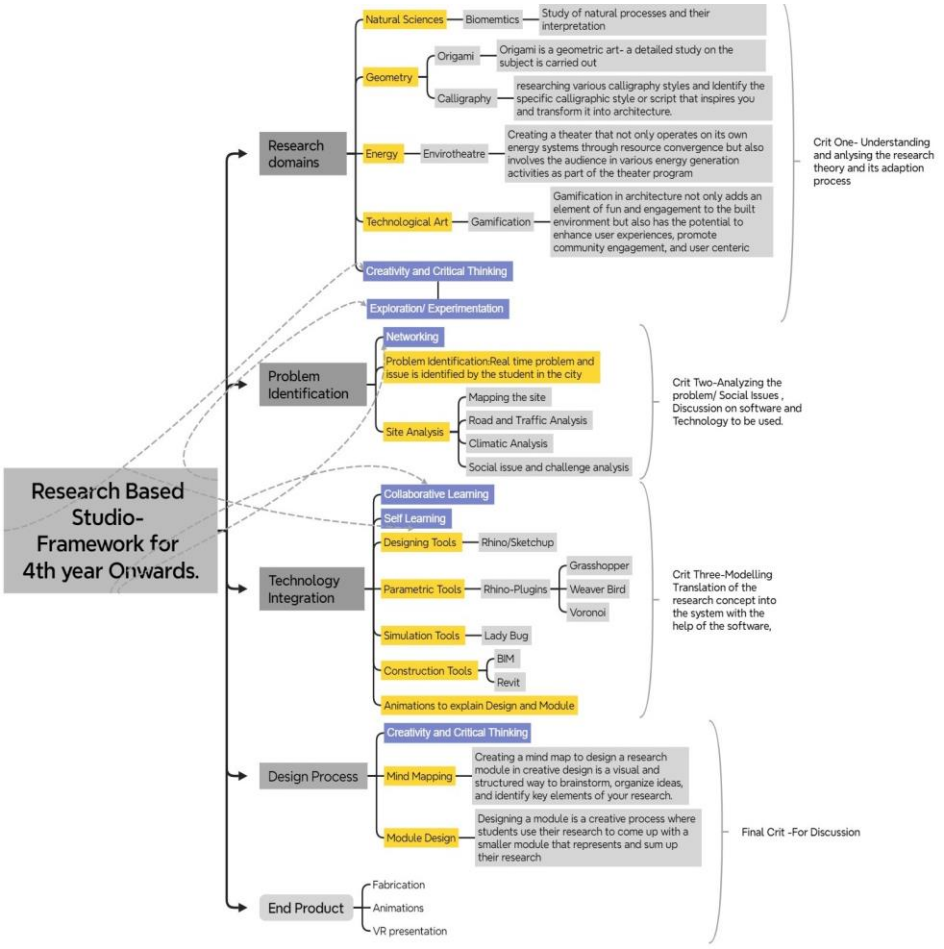

Fig 1-The Digital Design Studio Framework adopted to integrate Gamification in Architecture Studio

Teaching. (Ph.D. et al.- A Study of Studio Heterotopia in Transitioning Architecture Pedagogy)

To our knowledge, there is no current research on the effective use of gamification and VR/AR in architectural education in Pakistan. Integrating gamification into architectural studios offers a unique chance to enhance architectural pedagogy in the country. However, this opportunity requires further research to understand its practical applications and effects.

This gap requires in-depth research on gamification's role within architectural studio settings in Pakistan. The authors started this study by investigating gamification's methodology, implications, student engagement, and design competencies in a studio setting. Analyzing student projects and the educational outcomes of gamified projects would provide valuable insights for educators and policymakers on utilizing technology to boost architectural education. The proposed studio framework is shown in Fig 1 below; this research is used to validate this teaching framework and analyze its advantages and disadvantages while integrating a Digital Design Studio in Pakistan. In this paper, we will not be talking in-depth about the framework as it is not in the scope of this paper. However, this paper is

structured into three sections: The first section reviews the literature to identify and enrich existing theoretical frameworks for game design. The second section explores the students' projects that introduced gamification in architecture and reflects on the selected projects. This section discusses the strengths and limitations of the selected projects. The Last section summarizes the research findings and discusses potential future implications.

Literature Review

The scientific community has developed various educational games in architectural design. One example is the Summer Game, which enhances students' reflective thinking and design-making skills. It involves training in explicit judgment criteria and constructing images linked to architectural geometry. Students take on the role of designers and work in teams, while teachers act as clients. Another game is StringCWE, which focuses on rapidly prototyping architectural work in landscaping. Student-actors play the role of architects, designing on equal terms, while teacher-actors guide the process and evaluate design solutions. Lastly, the Cube Game emphasizes the financial aspects of architectural design, involving clients, architects, and builders. Players make decisions about lot pricing and construction costs for single-family homes. These games aim to provide hands-on learning experiences and foster critical thinking, decision-making, and collaboration skills among architecture students(Education in Computer Aided Architectural Design in Europe et al., n.d.).

Another exciting research(Goli et al., 2022) Presented the design of an educational tool as an interactive game for architectural students. It provided a platform to test students' knowledge during the design process through a focused, open-ended game. In this game, Students can compare the results of their game with famous buildings like Falling Water etc., to better comprehend the challenges of the design process. This designed game helped students to create a productive connection between their playing experiences and their design learning, which helps to bridge the gap between gaining knowledge and practically applying it. The new research emphasizes that contemporary architectural education should take advantage of the new student-centered approaches to improve students' learning efficiency(Emam et al., 2019)

Schnabel et al.'s study (2014) proposes a gamified framework for architectural education, incorporating Game Elements, Challenges, Process Integration, and Engagement. Applying the MDA (Mechanics, Dynamics, Aesthetics) framework tailors the mechanics to foster dynamic collaboration and creativity. The approach exemplifies stakeholder collaboration and feedback loops in mass housing design, enhancing learning experiences and outcomes through gamification.

Redondo E. *et al.* (2020) worked on how Gamification plays a significant role in enhancing the learning experience for architecture students. This project was named the EDUGAME4CITY research project. In this project, researchers incorporated gamified elements into the educational process. They observed how students were motivated and engaged in a more interactive and immersive way than the traditional way of learning. This project integrated gamification by generating 3D urban scenarios to meet user preferences and needs, forming the basis for gamified activities. Students collaborated while developing these urban interventions. Virtual simulation technology immersed students in urban environments(Redondo et al., 2020). Gamification elements were inserted into the simulation process, enhancing user interaction and engagement with the virtual world. In this project, gamification enhances student learning by making it more engaging, immersive, and effective in preparing students for real-world challenges in urban design practice.

Milovanovic and Moreau (2017) have provided empirical insights to demonstrate the practical applications of Virtual Reality in architectural pedagogy. Redondo et al. (2020) and Elsamahy (2020) studied how applying Gamification can impact student learning by motivating students and helping align with the demands of contemporary studio teaching in Architecture. Ehab et al. (2023) have explored the potential of using virtual reality in architectural design, explaining how using these tools in the studio environment enhances participatory design and decision-making amongst students.

In the Gamification process, framework design has an important role, according to a study

conducted by (Mora et al., 2015) provides This paper comprehensively reviews the literature on gamification design frameworks to comprehend and understand the various approaches to designing gaming frameworks. It analyses frameworks based on their background, scope, and approaches.

Although there is a lack of substantial studies on virtual reality (VR) in actual architectural practice, some professionals incorporate immersive VR into their daily design work. However, numerous experiments have been conducted to examine VR integration with architecture students and professionals(Milovanovic & Moreau, 2017). These studies have explored various aspects, such as the benefits of VR for students to understand structures and construction, comparisons of different VR systems, the implementation of new VR working environments for designers, the assessment of remote design collaboration using VR, and its integration into architecture school curricula. One notable study on VR integration in architectural education is the Penn State University Experiment, where Immersive space (V-shaped screen) was used to enhance the design process. 2nd and 3rd-year architecture students used the platform for a specific course and final project presentations. Students adapted the platform's setting to suit their needs for design or communication(Subhash & Cudney, 2018).

Schnabel et al. (2014) advocate for the MDA (Mechanics et al.) framework that enhances engagement and creativity. Similarly, Chou's Octalysis framework takes elements from games to make engaging real-life activities. He uses the elements as core drives to keep the user engaged. This literature collectively indicates the potential benefits of incorporating gamification, virtual reality, and augmented reality in architectural education. The frameworks discussed in the literature provide insight into how to gamify studio projects. However, further studies are required to adapt to local contexts, particularly in the Pakistani context. The following section enriches the frameworks found in the literature to develop games of architectural projects.

Framework

The literature on gamification in architectural education emphasizes the role of gamification and immersive technologies as critical directions. Some studies have focused on collaboration with different stakeholders. However, various researchers have put forward frameworks that provide multiple directions. Andrzej Marczewski's basic Gamification Framework and Chou's Octa lysis framework, found in the literature, provide a basic outline for designing a motivating game. To refine the framework for architectural education, this section synthesizes the basic processes from Marczewski's and the core drives from Chou's frameworks. The stages emphasize the steps required to gamify projects and evaluate the game in the context of architectural studios.

Framework Overview:

The framework combines Marczewski's gamification principles with Chou's Octalysis model to create a four-stage strategy to help designers develop and analyze games for architectural projects to improve them further. The framework's steps are designed to use gamification to improve architectural students' learning, engagement, and design skills.

Planning Stage:

To gamify an architectural project, the first step is to identify the critical elements of a game. This involves establishing objectives, identifying the target audience, and determining the scope of the gamification project. This process is like Marczewski's mechanics component. Moreover, designers must consider the motivational drives relevant to architectural students. These core motivational drives, as identified by Chou's Octalysis, are creativity, mastery, and autonomy. By understanding these drives, the designers engage the game and align with educational goals. For example, the game focus can be on awareness of sustainable practices. Finally, it is crucial to consider the factors that make a game engaging and valuable. By doing so, designers can create an effective gamification strategy that helps students achieve their educational goals.

Development and Design:

This stage involves the actual development of the game. The focus remains on creating learning experiences while ensuring they align with the identified core drives and educational objectives in the first stage. This stage aligns with Marczewski's Dynamic stage and considers user behavior. It can

include aspects such as competition, collaboration, social interaction, and exploration to guide behavior. The game should be designed to simulate real-world architectural challenges.

Execution and Interaction:
This stage is for implementation and testing. Students can interact with the game and engage with gamified elements. The Interaction stage or playing experience should also have some sense of achievement, such as earning a badge, the thrill of competition, and the joy of social connection. As discussed in the original frameworks, a sense of achievement keeps the participants interested. Designers should monitor interaction to ensure the activities foster engagement, learning, and collaboration.

Conclusion and Reflection:
During the evaluation stage, the game designer analyzes whether the game meets its objectives. This assessment can include the game's impact on the participants. Additionally, feedback can be collected to identify areas for improvement and further refine the game.
Optional Stages for Customization and Evaluation: Customization and personalization can increase participants' ownership and relevance. The game can also be periodically reviewed and updated based on feedback and technological advancements.
This improved framework provides a step-by-step strategy to develop an engaging game and analyze its effectiveness for teaching purposes.

Research Objectives
The study's primary goal is to delve into the effectiveness of game-based learning within architectural education, specifically within a studio setting in Pakistan. The research sets out to achieve the following objectives:

- Analyze the potential of game-based learning in an architectural studio.
- Assess how gamification can improve the learning in Design Studio
- Investigate the relevance and potential of VR and AR technologies in architectural education, especially in developing countries like Pakistan.
- Examine the strengths and limitations of Gamified projects.

Research Methodology
The study assesses game-based learning strategies by conducting a studio project in an architectural studio in Pakistan. The impact of gamification and VR/AR technologies in architectural education is investigated within a fourth-year design studio at the Department of Architecture University of Engineering and Technology Lahore. The project is conducted throughout the fourteen-week-long semester of Fall 2023. The paper outlines a detailed methodology for conducting two innovative studio projects that utilize gamification strategies to enhance learning in urban planning and architectural design and reflects upon the challenges and limitations of the process to find better solutions for the future.
One of the aims of this fourteen-week training in the studio is to broaden the student's knowledge of current design trends in architecture involving gamification, to give them the wherewithal to critique their assumptions and predispositions regarding the digital trends, and finally, to assist them in articulating critical design challenges in architecture. Studio focussed on the process-driven design rather than the final product. Four weeks were provided for developing the conceptual idea, which was very novel in Pakistan, so the students had to go through a lot of associated literature to understand better and clarify the concept of gamification in architecture. The next four weeks were allocated to discuss and understand the project with a game designer and to learn and practice Unreal Engine, the software linked to gamification. Two instructors (Authors) conducted the design studio as a team, supervising the work of thirty students. Only two students were working on gamification with the extra external help of a game designer. Although the studio was allotted ten working hours per week, the student had to work additional hours to get hold of the technical software with the help of online tutorials to resolve significant issues as there was no precedent available for such a project. This was one of the first time to use VR/AR in the design studio, and the department was not equipped with the tools and the students had to arrange VR sets on their own.
Using gamification, the projects integrate architectural theory with immersive technologies.

They aim to enrich the learning experience by offering an engaging and interactive educational game. A key aspect of this methodology is the development of a design feedback loop. Based on decision theory principles, the feedback loop can optimize user experience. The interactive feedback loop facilitates user engagement, leading to greater awareness and active involvement.

Case-Studies: Game Development in Digital Architecture Studio

Initiation of the Studio on Game Learning involved a comprehensive exploration of gamification concepts and principles through an in-depth review of gaming literature. The handouts that were provided to the students included: Gaming as a disembodied experience of the City: From Assassin's Creed to "Smart Learner by (Porreca et al., 2020) and ICT for user experience transformations in sustainable smart tourism Projects VR, AR, and MR in Rome's Historical Center by (Geropanta et al., n.d.) The studio commenced by immersing participants in relevant gaming materials, laying the groundwork to understand and explore best practices. This theoretical foundation aimed to ascertain how gamification could effectively be applied to urban planning and design. Architectural studio projects included in the study integrate VR/AR gamification using tools like Unreal Engine, ChatGPT 4, and Grasshopper for student projects and design.

Project One: VR Simulation for Urban Pedestrianization

User feedback plays a crucial role in gamification Project 1. It utilizes a co-design approach and promotes end-user engagement through user-centered design principles. This project is optimized for VR headsets for immersive user experience.

The gamified virtual environment brings immersive qualities and facilitates interactive experiences. The participatory approach enables users to contribute insights and shape design outcomes actively. The iterative refinement process, driven by user feedback, aimed to deliver a user-centric and inclusive virtual experience aligned with diverse audience preferences. In summary, the co-design approach, hardware optimization, and VR integration create an immersive and refined virtual environment for co-designing space. This project designs a Car-Free City Center where players' behavior provides valuable insight for the design. The subsequent analysis focused on extracting challenges and benefits from these behaviors for an informed design process.

The site chosen for transforming into car-free zones is Liberty Market in Lahore. The first stage thoroughly examined traffic patterns, land use, and community needs. This stage develops an understanding of the fundamental challenges inherent to the site. Following this, 2D design concepts and sketches were generated using design software like AutoCAD. Rhino and Grasshopper are used to develop 3D. Designing a detailed and proposed new environment for the car-free zone involved creative architectural thinking. Some specific game elements, challenges and rewards systems, and several interactive components were added in Unreal Engine to incorporate gaming strategies. The use of Unreal Engine includes designing interactive features and providing unified and maneuverable navigation within the designed platform. This virtual reality experience required repetitive testing and optimization strategies to produce close-to-desired results.

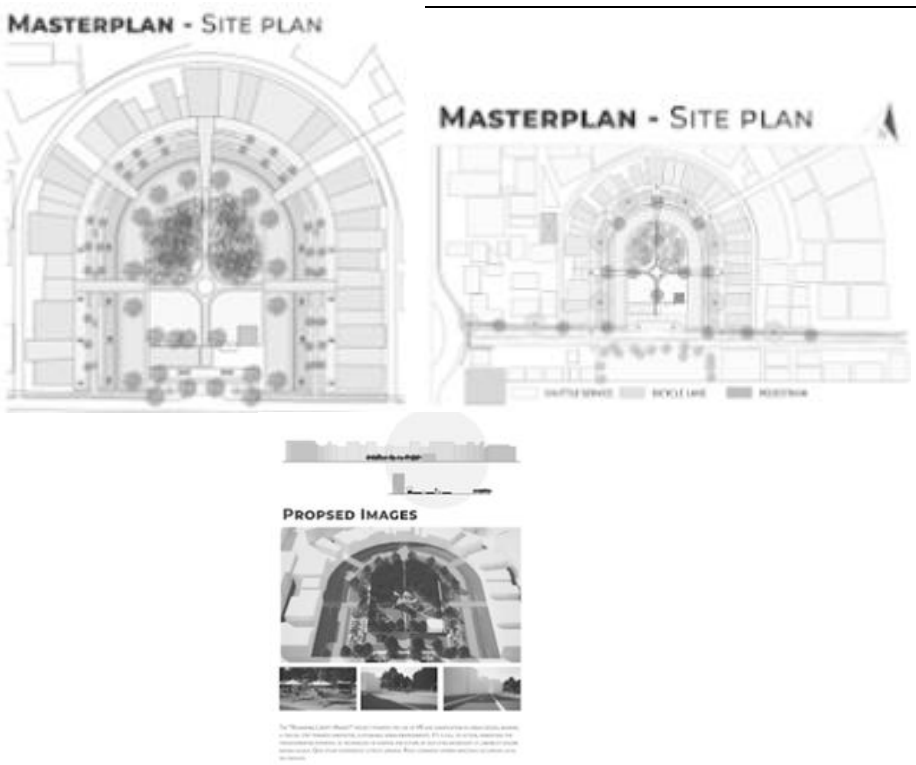

Fig 1- Site of Liberty Market Lahore for Car Free Parking of Project One (courtesy: Farheen Ahmed)

Objective: Transform Lahore's Liberty Market into a virtual car-free zone to explore the benefits of pedestrianized spaces.

Approach: Create a VR simulation that lets users interact with a car-free Liberty Market, designed to inform and engage users about urban pedestrianization through interactive tasks and reward mechanisms.

Gamification Strategy:

Method: The project follows a structured approach, from initial strategic planning and data collection on traffic and public opinion to the design and development of the VR simulation, user interaction, and final analysis based on gathered data and feedback.

Planning and Analysis: This project relies on community contribution by involving participants in the market's transformation.

Design stage: The game designer provides virtual spaces for users with real-time feedback on their design choices.

Interaction: The game is designed to encourage collaboration and introduces challenges for keeping users engaged.

Reflection: Participants are also led to reflect on their choices. The users can see in-game outcomes, resulting in strategic thinking about urban planning.

Gamification Aspects:

Planning Stage:

This stage identifies the architectural goal of engaging participants in enhancing community well-being by transforming the Liberty Market into a pedestrian-centric area. The game further allows participants to track their contributions and witness the tangible impacts of their design decisions.

Development and Design:

The game is designed so that gamers can actively participate in designing pedestrian pathways and green spaces. They also receive immediate visual and feedback on their design's impact within the VR environment. This leads to empowering and making users aware of their choices.

Execution and Interaction:

The participant's decisions affect the virtual market's layout. The game provides feedback, initiating a sense of responsibility and ownership. The game also offers challenging scenarios within the simulation to maintain user engagement.

Conclusion and Reflection:

The game also shows the consequences of inaction or poor planning decisions within the game. The game encourages users to make thoughtful and sustainable choices. The game designers have also considered implementing time-bound challenges or resource limitations to mimic real-life constraints.

Reflection

Project 1 unfolds as a transformative venture with profound implications for the sustainable urban future of the city of Lahore. The project's ambition was to create an environment-friendly space. The transformation of Liberty Market into a pedestrian-centric space marks a significant leap toward alleviating vehicular congestion, achieved by rerouting traffic and establishing car-free zones augmented by eco-friendly transportation alternatives. Students detailed 3D models using SketchUp and leveraging Unreal Engine 5 at the visualization stage. Including hyper-realistic materials from Quixel Bridge and assets from the Epic Games Marketplace enriched the virtual landscape, providing a palpable sense of place. Participants contribute to the iterative design session experienced through VR. Each session becomes closer to realizing a sustainable, inclusive, and vibrant community space. The project's integration of VR and gamification emerged as a revolutionary educational paradigm, propelling students beyond traditional design thinking and immersing them in the process-oriented creation. This shift from a product-focused to a process-oriented mindset was initially challenging and time-intensive, demanding a recalibration of conventional learning approaches. Overall, the game is engaging and makes participants aware of sustainable choices. The simulated environment facilitates an interactive learning space where immediate feedback evolves the design. In Pakistan, students have transitioned from focusing on the design outcome to embracing the design process and the participatory design approach.

Challenges and Limitations:

One of the significant constraints faced in this project was time. The semester's timeline confined the project's scope and ambition. The time constraint limited the extent of feedback that could be integrated. Furthermore, some design elements were only conceptually developed and couldn't be integrated into the game. Another major challenge was the skill of students. The dynamic nature of the feedback loop posed challenges in continuously updating the model to reflect real-time input. The complexities of urban planning and the need to learn new software within one academic semester restricted in-depth study. The detail-oriented nature of VR game development in a studio also needs supporting courses outside the studio setting. Pakistani institutes are still struggling to adopt new technology and interdisciplinary approaches.

The project culminated in a dynamic VR experience. Stakeholders can interact with the proposed Liberty Market and offer a vision for the market's potential future. This project also explores the discourse on participatory design and co-creation in architecture. While still a prototype, the Liberty Market initiative offers transformative possibilities of VR and gamification in crafting urban environments that prioritize sustainability and community engagement. Furthermore, it is a prototype for broader urban planning and policymaking applications. It exemplifies how immersive technology paired with participatory design can forge tangible urban solutions.

Project Two: Virtual Reality for Democratic Urban Planning

This project simulates contrasting worlds—a dystopian setting and a solar-powered utopian city. The contrasting worlds enhance public engagement and understanding of sustainable urban design. The student uses existing theories to provide a theoretical foundation and precedents for the two cities. Furthermore, it offers valuable insights into the application of technology for public engagement. The Project also uses Rhino and Grasshopper for modeling, leveraging algorithmic capabilities to generate intricate structures and environments. Later, the student takes the project in Unreal Engine to animate these models, rendering different components of utopian and dystopian cities in separate levels that serve as immersive stages for user interaction.

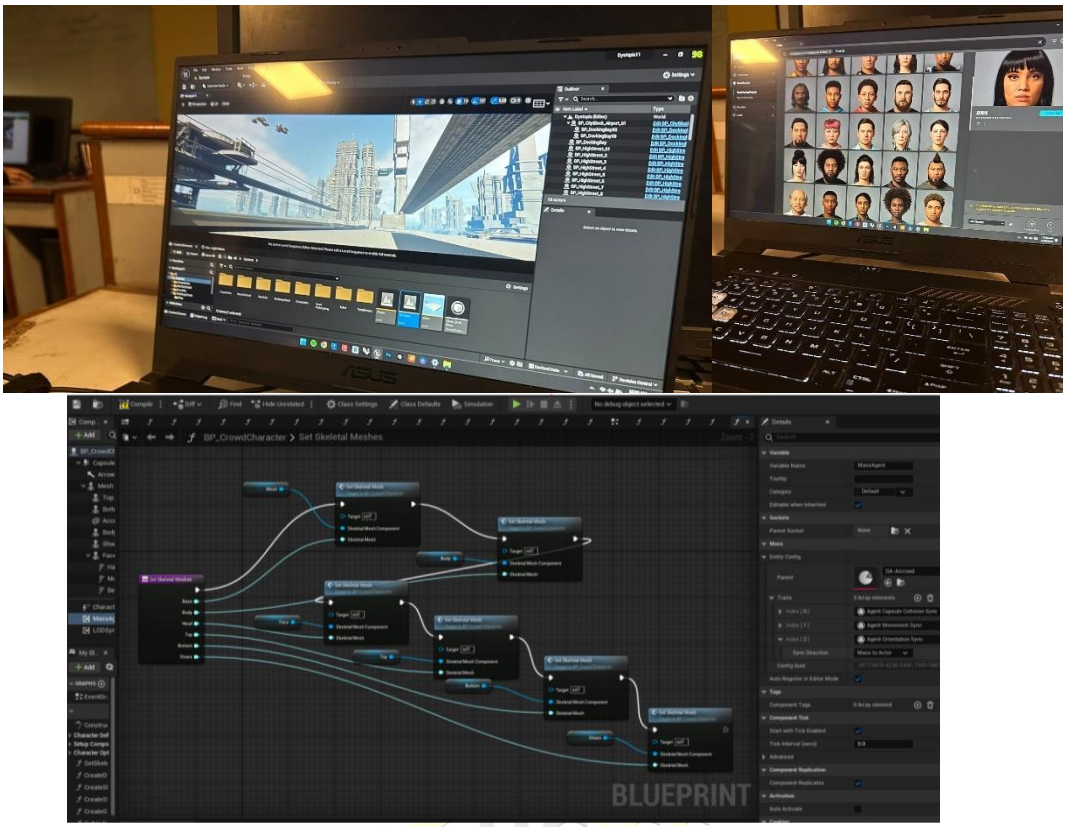

Fig 2: Project Two -Exploring the potential of Unreal Engine in the design process (Source: Dawood Asim Paracha)

The game designer uses interactive storytelling to create two distinct virtual realms—a dystopian landscape and a utopian solar city. The critical aspect of the project lies in the conditional transitions between the two worlds, influenced by user decisions reflecting ethical choices(Budi Santosa, 2018). Positive actions prompt a transformation towards the utopian solar city, while negative choices steer the environment into dystopia. This dynamic is the game's focal point, recognizing that virtual environments substantially influence user decision-making and emotional states. The scripting of gaming levels within Unreal Engine includes a portal with a pre-entry question, allowing user responses to determine the world they enter. This method extends beyond narrative engagement, serving as an experimental exploration of behavioral responses within virtual spaces.

VR technology is relatively new in education in Pakistan, and its practical applications in studios have not been fully explored in this region. This studio project helps to demonstrate how gamification and virtual reality can be used to control architectural barbarism. This methodology is used in studio teachings about how the absence of thoughtful design can impact the world by stepping into a virtual world. Using Unreal Engine and Chat GPT 4 in architectural studies gave professionals (jurors) insights into how an architect can be more creative and learn about environmental issues before designing anything on the ground.

Objective: Utilize VR to engage the public in sustainable urban development discussions.

Approach: Develop VR experiences contrasting dystopian scenarios with sustainable urban designs to promote ecological values and community inclusiveness inspired by Solarpunk principles.

Method: Beginning with a comprehensive literature review and strategic planning, the project involves developing a VR platform for urban design interaction. This will lead to evaluating its

impact on users' perspectives on sustainable urbanism.

Gamification Strategy:

Planning: The game designer identifies user awareness as the game's primary goal. Users are engaged in a meaningful mission to transform urban environments. This game's target audience mainly comprises architects and stakeholders interested in city planning.

Design: The interactive game allows users to influence the virtual city. They can also see the outcome of their decisions, such as their city turning into a dystopia or utopia. The users become aware of the consequences of their decisions and develop a sense of ownership and creative input.

Interaction: Players develop connections with their design and remain curious as their decision can lead to a better or worse future.

Reflection: This game emphasizes the consequences of user choices, encouraging thoughtful participation in urban sustainability.

Gamification Aspects:

Planning stages:

The primary purpose of this game is to develop awareness and a sense of purpose. Players can see how their decisions can lead to a better or worse city. Users can track their progress and witness the effects of the virtual urban environment.

Development and Design:

The game is designed to align user achievements with architectural goals. Players have the autonomy to make impactful design choices in the virtual city. They can continuously see the direct results of their actions, becoming aware and responsible.

Execution and Interaction:

Players interact with game elements and, as mentioned before, can see the results of their execution. The game also has aspects of Unpredictability and Curiosity, which add a dynamic element, making the gaming experience remain engaging.

Conclusion and Reflection:

Through loss and avoidance, the game mirrors the real-world implications of urban planning decisions. The players learn about sustainable planning in a fun and immersive environment.

Reflection

Project Two challenges participants to navigate between contrasting realities based on their choices. As users continue to play, they learn about sustainability concepts and the effect of their choices on city-states. The interactive project makes users aware of the consequences of the choices while playing a game to create a utopia. The student spent considerable time defining utopia, which kept the focus on conceptualizing and away from developing the game. Consequently, the game's scope was narrowed, focusing only on a few outcomes of the contrasting realms rather than on comprehensive urban planning. Due to the limited time and the intricate development required, the exploration of game theory concepts was limited to a single-player experience. While this approach did not fully exploit the collaborative potential inherent in game theory, it still showcased the significant impact that individual user experiences can have on attitudes toward environmental stewardship. As users move through the digital worlds, the project serves as a laboratory for studying virtual experiences on decision-making and responses. The decision-making portals embedded within the game's narrative deepen the immersive experience and provide an interactive experience within virtual environments. Despite the time constraints and a narrower game scale, Project Two proved the viability of VR as a tool for engaging a diverse group of stakeholders—from developers and architects to landlords and residents—in the conversation about sustainable urban futures. In conclusion, Project Two, though a prototype, offers gamification's transformative potential in educating, engaging, and empowering individuals to make proactive choices for a sustainable urban environment.

This project provides an engaging platform for users to experience and understand the impacts of their decisions on urban environments. The game allows users to experience the consequences of different choices, which educates players on the importance of sustainability in urban planning, potentially leading to more environmentally responsible behavior. The conditional transitions between the virtual worlds based on user decisions

provide valuable insights into how people might react to various urban planning strategies and their preferences for sustainable living spaces(Rogers & Schnabel, n.d.)The use of narrative and storytelling within the VR experience helps communicate complex ideas in an accessible manner. The concepts of dystopia and utopia emphasize the importance of single actions. Users can not consider any action insignificant and can become more aware.

Challenges and Limitations:

Initial debates and focus on defining 'utopia' diverted attention from developing the game. The outcome had a narrower scope than initially intended. The time-intensive nature of developing a sophisticated VR environment limited the ability to gather extensive feedback and refine the project within the academic timeframe. The solo-player approach did not fully explore the collaborative and competitive aspects that game theory could introduce, potentially limiting the understanding of group dynamics in urban design choices. The project's reliance on high-end technology may not be easily replicable in different settings, especially where resources are constrained. This holds especially true for Pakistan's public sector universities with limited resources. The sophisticated nature of the VR models and the need for continuous updates based on feedback present challenges in maintaining and evolving the design over time. While the project offers an innovative look at urban sustainability, its impact may be confined to the academic or simulation level, with real-world application remaining a challenge to be addressed.

Fig 3: Jurors exploring the virtual dystopic city on jury day. (Author)

Review

The result of integrating Gamification into architectural education can be analyzed by studying these two distinct approaches to problem-solving in the design studio. The transformation of the Liberty Market into a car-free zone through the

immersive experience of a virtual reality game, users engaging with and exploring the proposed car-free zone can provide some essential data and information about the main challenges of planning and user needs beforehand to the architects. Other than that, several tests can be done to develop productive outcomes for the planning and design of this market by virtually experiencing it beforehand.

The second project explores a narrative-driven approach, incorporating user decisions to influence the outcome. The game can be used to design spaces that are well-informed by the user. Doing such a project provided students with various learning excursions and enhanced the critical thinking that a student requires from any studio project. Leveraging interactive storytelling and user choices gave the learner a deeper understanding of the importance of user study in architecture design and how to incorporate it intelligently. Here, gamification has been used for both experiential learning and narrative-driven simulations that prompt users to consider the consequences of their decisions. The level of architectural learning can be assessed by the students' engagement in working on these projects. These projects represent the transformative shift in design learning and teaching methods. The use of immersive technologies and tools in Architectural studio teaching has immense potential for enhancing spatial awareness and communication in design. These studio experimentations are possible because of the students' efforts in pursuing these projects; more appropriate integration of these tools depends on accessible VR labs, seamless technological integration in the curriculum, and attention to the learning outcomes in studios.

Strengths and Limitations

Students' spatial awareness is enhanced When they practice exercises like these in the studio. It provides a profound understanding of spatial dynamics, enriching their grip on architectural design concepts. Experiencing Virtual reality at the earliest stage in design helps to enhance their ability to conceptualize and visualize complex architectural spaces effectively in the future. The successful conduction of these studio projects proved that with little effort and perception, VR and AR can serve as dynamic and innovative educational tools that can revolutionize traditional teaching methods in architecture in Pakistan. Students can develop technical skills by exploring Unreal Engine and gaming software. This project's hands-on experience helped them understand self-learning techniques and interdisciplinary collaborations. By the end of the project, students were confident in using cutting-edge tools and technologies. These two students had to work with different professionals to produce their results, as they learned from the game designers/ software engineers while discussing their project challenges. This way, they learned to collaborate as they would in real-world architectural practice. This exercise has prepared the students to understand and engage themselves in the evolving demands of the contemporary architecture profession. It has equipped them with the adaptability needed to handle the fear attached to the technological shifts in architecture and stay confident.

Although looking at the Pakistani Architectural education scenario, significant challenges and limitations are attached to such project exercises. The most significant limitation is the variance in technical readiness among Pakistani architectural schools. While some institutions adopt the necessary infrastructure and tools for seamless practice, others are ignorant of such technological advancements. Projects like these can only be incorporated into studio teaching if schools provide comprehensive infrastructural and technological development by ensuring equitable access to these educational tools. The other major limitation is upgrading the traditional teaching methodology in architecture to introduce these novel interfaces and interactive modes, which may require additional time and effort from the faculty and students. Overcoming this fear of change, prevalent in many architectural schools in Pakistan, is crucial for maximizing this integration in architectural education.

The urgent and successful implementation of gamification demands accessible VR labs and seamless technological integration in architectural schools. Every educational institution must make a significant financial investment, which could be time-consuming and problematic and add to the delay in the process. It is also important to note that this study focused on only two projects, which may limit the generalizability of its findings. Expanding the research to include a broader range of architectural programs can provide a more detailed

understanding of the challenges and opportunities associated with this context.

Conclusion and Discussion:

Virtual Reality and gamification have gradually become advanced in architectural design phases nowadays(Elsamahy, 2020) Different advancements in digital technology that were formerly thought to be challenging to undertake are now within reach, notwithstanding their complexity with time. This makes up for the problem of schools in Pakistan that are behind in technological upgrades and are open to learning and using these tools in academia. The exploration of gamification in studios in Pakistan has unearthed critical insights that underscore the transformative potential of this approach. This research has attempted to answer the overarching question modeled on the role of gamification in studios for student learning in Pakistan. It opens future avenues for this kind of studio education. Consistent with Schnabel et al. (2014), gamification transcends mere play; its core lies in embedding engaging, interactive elements within traditionally collaborative and participatory activities. Distinguishing gamification from 'serious games'—designed for skill enhancement and training—and game theory's analytical focus on decision-making, this study demonstrates gamification's power to foster strategic engagement and collaborative problem-solving in architectural contexts.

The studio's gamification approach, integrating tools like Unreal Engine, Grasshopper, and Chat GPT 4, pushed students into a dynamic design competition and innovation realm. Today's generation of learners is bright and well-equipped with technology; keeping them engaged is the main success of any studio project. The interactivity and immediate feedback mechanisms inherent in this gamification approach are essential in motivating and engaging students. The instructor witnessed continuous improvement and motivation to explore throughout the semester while working on these projects, mainly because of the immediate response from the process. The instructor not only witnessed the embedded simulation game elements in the project activities, but also, students were immersed in their creations, critically evaluating and refining their designs in real-time, and engaged in a productive discussion with their peers. Prior studies by Milovanovic and Moreau (2017) resonate with this research, highlighting the enhancement of spatial knowledge and design understanding facilitated by VR and AR in learners. Also, one should explore more techniques and strategies for integrating immersive experiences in contemporary architectural pedagogy.

By exploring these projects in an otherwise very conservative studio environment, it can be assessed that gamification has much transformative potential in architectural education, and it can serve as a roadmap for educators, policymakers, and stakeholders in Pakistan. Experimentations and studies like these should be conducted in the future to understand the necessity for embracing innovative pedagogical tools to groom and train a future generation of architects. This study stands as a testament to the art of gamification in shaping an engaging and effective learning environment in studios in Pakistan.

Future Implications

Integration of gamification and VR/AR technologies is not merely an experiment but a foundational practice for future curricula in architecture. Today's learner demands a dynamic and immersive learning environment, urging educators to shift from conventional pedagogies to interactive and experiential methodologies.

The architectural curriculum should evolve to integrate gamification techniques into the core of architectural education, changing studios into vibrant, interactive spaces for engaged learners. The urgent need and demand for technical infrastructure to support these technologies should initiate investments in VR and AR resources, eventually establishing specialized labs within architectural schools. Students trained in such a way will likely translate into more cohesive team workers and collaborators rather than just designers. Implementing this kind of participatory education could produce a generation of architects who are not only technologically adept but also critical thinkers and game changers. The educational policy may need to adapt based on the interest of the younger learners in interactive and immersive learning. It should facilitate this integration in the architectural schools and curriculum, especially in Pakistan. Policymakers must recognize this domain's unique challenges

and opportunities within the Pakistani context. Regulatory bodies should design strategies to accommodate these tools and environments and work towards overcoming infrastructural and economic constraints. Faculty should encourage the use of immersive technologies in studios and otherwise and should be trained to enforce the use of advanced educational tools across different regions and institutions across Pakistan. Significant investment involves upgrading hardware, high-speed internet access, and training educators to utilize these tools in their teaching practices effectively. The importance of integrating these strategies includes encouraging partnerships between educational institutions and the gaming industry in Pakistan that could help generate revenue and new limitless possibilities in architectural learning.

Recommendations for Future Research:

Further research should expand the scope of this work and include multiple institutions and projects that could offer a more detailed outline of the impact across diverse educational settings. This can help us better understand the challenges and positive outcomes. This should expand by integrating quantitative analyses alongside qualitative insights to provide a robust understanding of the outcomes of gamified learning tools in architecture. This can even intervene at an early stage in architecture learning. The curriculum should design longitudinal studies that shed light on the sustained impacts of this approach, helping graduates with a smooth transition into professional roles. This approach is a classic example of an interdisciplinary study that provides the learner insight into educational technology, psychology, and design theory. This could enrich the understanding and application of gamified learning in architecture.

Acknowledgments:

We would like to thank Ar Hasnain Jawed, who came to help and guide students twice during the semester on how to take on this design challenge. Our fourth-year students Dawood Asim Paracha and Farheen Ahmad took up this idea as their studio project. They bravely explored the challenges of this project throughout the semester—Architecture Department University of Engineering and Technology Lahore.

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