Integrating Gamification with BIM for Enhancing Participatory Design

Zeynep Özge Yalçın[1]

ORCID NO: 0000-0001-9165-8999[1]

[1] Izmir Institute of Technology, Faculty of Architecture, Department of Architecture, İzmir, Türkiye

The combination of gamification and Building Information Modeling (BIM) can be described to support user participation, decision-making, and collaboration in design contexts. Within this aim, this paper presents a literature review on the potential of using gamification in the BIM framework to create immersive participatory design environments. Active involvement of stakeholders by the corporation of gamified components such as challenges and interactive simulations into the design process enables better decisions and enhances user experience. Further, gamification integrated into BIM brings the potential to improve user behavior and decision-making at all stages of the design lifecycle but also the limitations and challenges. It can encourage stakeholder interaction and provide real-time input allowing various stakeholders to make meaningful contributions towards sustainability goals. This study examines recent developments and trends in extended reality (XR), augmented reality (AR), and virtual reality (VR). These advances significantly enhance gamified Building Information Modeling (BIM) environments as being immersive. In addition, it points out some challenges, and ethical concerns encountered with these technologies. Furthermore, this paper highlights some tools and their advantages, disadvantages, pricing, and key elements. Designers can create interactive experiences by combining these technologies with virtual and physical environments. BIM environments powered by gamification can be used in BIM workflows to reach their full potential in shaping future design practices. These include ways to advance cooperative design processes by creating immersive spaces for different stakeholders' interests and keeping up with emergent technology.

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Corresponding Author:
zeynepozge.yalcin@gmail.com

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Katılımcı Tasarımı Geliştirmek için Oyunlaştırmanın BIM ile Bütünleştirilmesi

Zeynep Özge Yalçın [1]

ORCID NO: 0000-0001-9165-8999 [1]

[1] İzmir Yüksek Teknoloji Enstitüsü, Mimarlık Fakültesi, Mimarlık Bölümü, İzmir, Türkiye

Oyunlaştırma ve Yapı Bilgi Modellemesi (BIM) kombinasyonu, tasarım bağlamlarında kullanıcı katılımını, karar vermeyi ve işbirliğini desteklemek için tanımlanabilir. Bu amaç doğrultusunda, bu makale, sürükleyici katılımcı tasarım ortamları oluşturmak için BIM çerçevesinde oyunlaştırma kullanımının potansiyeli üzerine bir literatür taraması sunmaktadır. Zorluklar ve etkileşimli simülasyonlar gibi oyunlaştırılmış bileşenlerin tasarım sürecine dahil edilmesiyle paydaşların aktif katılımı daha iyi kararlar alınmasını sağlar ve kullanıcı deneyimini geliştirir. Ayrıca, BIM'e entegre edilen oyunlaştırma, tasarım yaşam döngüsünün tüm aşamalarında kullanıcı davranışını ve karar verme sürecini iyileştirme potansiyelinin yanı sıra sınırlamalar ve zorluklar da getirmektedir. Paydaş etkileşimini teşvik edebilir ve çeşitli paydaşların sürdürülebilirlik hedeflerine anlamlı katkılarda bulunmasına olanak tanıyan gerçek zamanlı girdi sağlayabilir. Bu çalışma, genişletilmiş gerçeklik (XR), artırılmış gerçeklik (AR) ve sanal gerçeklik (VR) alanlarındaki son gelişmeleri ve eğilimleri incelemektedir. Bu gelişmeler, oyunlaştırılmış Yapı Bilgi Modellemesi (BIM) ortamlarını sürükleyici olarak önemli ölçüde geliştirmektedir. Ayrıca, bu teknolojilerle karşılaşılan bazı zorluklara ve etik kaygılara da işaret etmektedir. Ayrıca, bu makale bazı araçları ve bunların avantajlarını, dezavantajlarını, fiyatlarını ve temel unsurlarını vurgulamaktadır. Tasarımcılar bu teknolojileri sanal ve fiziksel ortamlarla birleştirerek etkileşimli deneyimler yaratabilirler. Oyunlaştırma ile desteklenen BIM ortamları, gelecekteki tasarım uygulamalarını şekillendirmede tam potansiyellerine ulaşmak için BIM iş akışlarında kullanılabilir. Bunlar arasında, farklı paydaşların ilgi alanlarına yönelik sürükleyici alanlar yaratarak ve gelişen teknolojiye ayak uydurarak işbirliğine dayalı tasarım süreçlerini ilerletmenin yolları yer almaktadır.

Anahtar Kelimeler: Oyunlaştırma, Mimari, Mimari Tasarım, Tasarım Stüdyosu.

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Sorumlu Yazar:
zeynepozge.yalcin@gmail.com

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1. INTRODUCTION

This modern architectural technique for incorporating gamification techniques into Building Information Modeling (BIM) is still in its infancy. The new approach involves game design features such as obstacles, incentives, and interactive experiences in customary design workflows to achieve greater user motivation, decision-making, and collaboration (Selin et al., 2019; Zichermann & Cunningham, 2011). The main research method used in this study is an extensive review of the literature. With a special emphasis on participatory design and extended reality technologies, the review attempts to synthesize the body of research that has already been done about gamification and BIM integration. The way gamification has been included in BIM and participatory design processes, as well as the possible advantages and difficulties of doing so, have all been critically examined thanks to this methodology. There are two major research questions for this study: Initially, what could be the future directions and ethical challenges that can address the participatory design, cooperation, decision-making processes, and user engagement while integrating gamification approaches into BIM? This question highlights the complexity and attendant hurdles in considering the benefits and ethical issues derived from such integration. Secondly, how does participation in design throughout the lifecycle of a project change due to the adoption of gamified BIM environments? How can these be customized for different stakeholders' needs? Design projects benefit greatly from collective intelligence including these perspectives seeing that different stakeholders contribute their knowledge towards common goals. These have attractive implications for stakeholders and end users (Luck, 2003, 2007; Hou and Rios, 2003). Gamification combined with BIM offers an advanced possibility for improving collaboration, decision-making, and user involvement through the design process. This can be achieved through the gamified components that promote active participation of actors leading to improved user experiences and making informed decisions (Hanus & Fox, 2015; Hassan & Hamari, 2020; Hofacker et al., 2016). However, it also contains challenges covering data security, equity, and unintended outcomes (Bevins & Howard, 2018). Designers should address gamification applications

parallel with cultural norms and values (Armstrong & Landers, 2018). The application of BIM is expected to undergo technologically based transformations in the future through the adoption of virtual reality (VR), augmented reality (AR), and extended reality (XR) (Ng et al., 2023). These technologies and simulations through which reality gets mixed with the virtual world become possible and may extend creativity and collaboration in the design environments (Rubio-Tamayo et al., 2017; Schrom-Feiertag et al., 2020). VR, AR, and XR can be taught in interactive and sensory groups. Accordingly, one can use it as a tool that architects use to involve stakeholders in the decision-making process and transform their physical setting for better results according to their preferences and objectives (Jamei et al., 2006; Sanchez-Sepulveda et al., 2019). Therefore, gamification combined with BIM offers a groundbreaking approach for busier, holistic, and diversity-based design paradigms. By incorporating gamified approaches within immersive systems, designers can develop socially beneficial, ethically responsible spaces for creative authoring and design participation (Petrova et al., 2017). By bolstering the overall user experience, it elevates the standardized approach to design and enriches the design process for a better future.

2. PARTICIPATORY DESIGN IN THE DIGITAL ERA: LEVERAGING BIM FOR INCLUSIVE COLLABORATION

Specifically, about design-oriented techniques such as toolmaking (Gaver et al., 1999), analog workshops (Gaver, 2012), or design probes (Mattelmäki, 2006), participatory design shares commonalities primarily in this regard. It seems that the more the specialists also become part of the user set, the harder the line of authorship and the more difficult it is to design. Luck (2003, 2007) contends that the knowledge exchange and the seeking of more refined design perspectives can be facilitated and realized if designers draw upon the capabilities of the userbase to ensure good design guidance; explore potential design outcomes within the user's collaborative initiative; and enhance efficient interaction with users. Developments in digital technology have created a lot of tools and software that are being integrated into participatory design. Some examples of these tools and software are video games, simulations, virtual charrettes, and data

visualization (Hou & Rios, 2003). This could occur using the application of digital technologies to enable users to experience actual living environments and design processes as they take place and appreciate some of the intricate social challenges that stem from their habitats and generate intelligent input (Al-Kodmany, 2001). For example, the use of technologies like virtual and augmented reality, extended reality, gamification, and building information modeling, can all be leveraged to create more engaging experiences. BIM environments can be additional to consumer engagement or peer decision-making and collaboration in design contexts and attract people who are uncomfortable about hand drawing and handcrafting to express themselves through interactive digital interfaces exploring the city appreciation. Both the users and the stakeholders can engage in it actively and providing preliminary response incentives to increase engagement, could enhance user experience. The National Institute of Building Sciences (Eastman et al., 2011) has a better description for BIM as "an integrated planning, design, construction, and operation process using a digital representation of the physical and functional properties of each building form in a computable object model with life cycle support." Eastman (2011) on the other hand, defines BIM as a modeling technology and related set of processes to produce, and exchange, which not only refers to building models but can also refer to other defined models of engineered systems such as the stages in production and the stages along the project lifecycle. BIM allows all important design decisions to be made digitally at the working drawing stage before the start of actual construction. This raises the level of confidence in every aspect of the project, including goals, sustainability, quality, cost, and timeline. The impact of BIM on design is noticeable at every stage of the building process. For instance, it facilitates integration and feedback for early conceptual design decisions (Elghaish and Abrishami, 2020). Energy efficiency standards are also incorporated at the design stage (Beazley et al., 2017; Jalaei et al., 2020). Finally, it evaluates a variety of construction alternatives' inherent environmental impacts (Röck et al., 2018; Rezaei et al., 2019). Construction-level modeling, which includes requirements, specifications, and cost estimation, is the initial step, according to Sadeghi et al. (2019) and Wang et al. (2017). Next is the support for new information workflows and the integration of engineering services. The

construction of the collaborative design integration is complete. To evaluate different design possibilities and optimize design performance, construction BIM aims to replicate construction project processes and tasks (Eastman et al., 2011). As a result, BIM is one of the digital tools for simulating virtual environments associated with infrastructure, building, and design projects (Sanchez et al., 2022). In addition to increasing user experience by enhancing users' engagement with 3D models, it can also improve participatory design within immersive settings and produce more productive schematics and construction design drawings for new building renovation works (Kapogiannis et al., 2020). There hasn't been much research done on user-3D model interactions, despite evidence that suggests gamification techniques could be added to 3D modeling software platforms to increase user engagement (Kapogiannis, 2020). A framework that enables people to create immersive environments using VR devices like Oculus Rift, for example, could be developed by combining gamified BIM with participatory design. Wearing AR glasses like HoloLens, users would walk through architectural designs while holding controllers that would allow them to interact with various building components represented by XR objects displayed around construction sites.

3. INTEGRATING GAMIFICATION WITH BIM FOR ENHANCING PARTICIPATORY DESIGN

The meaning given to gamification is the incorporation of design elements from games into non-game environments to motivate and engage people (Selin et al.,2019; Zichermann and Cunningham, 2011). Involved experiences for individuals should have gaming features in them and this means that they must become part of our everyday life systems even outside sports activities. "Applying game mechanics, aesthetics, and game thinking to engage people, motivate action, promote learning, and solve problems" is one of the ways how Kapp (2012:10) defined gamification. The basis of gamification is the Human-Computer interface theory combined with theories related to incentives. According to Armstrong & Landers (2018) using digital or analog means of presenting these features involves referring to them as games while we talk about applying structural design patterns and

concepts for enhancing employees' involvement in workplaces (Bevins and Howard, 2018). This new tactic becomes valuable under high-stakes conditions since it allows users to make comparisons by choosing among alternatives easily which could not be possible if they were only described in words that may vary greatly based on different interpretations given by each person (Pham & Bui, 2023). In the article, Koivisto and Hamari (2019) defined gamification as an approach to design that seeks to make systems and services more enjoyable through "game-like" experiences or by borrowing design elements from games. They argue that gamification is used in marketing, health, and education among other fields to enhance user participation (Hanus & Fox 2015; Hassan & Hamari 2020; Hofacker et al. 2016). This has led to organizations both in the public and private sectors adopting gamification together with smart technology as a way of raising the levels of engagement with their audiences. According to Deterding et al. (2011), gamification may be described as an umbrella term referring loosely to the use of video game mechanics and elements outside the gaming context to improve user experience (UX) and increase user engagement with the system. In the construction industry, after Building Information Modelling (BIM) was invented along with digital simulations and virtual environments, there emerged methodologies grounded on digitization such as gamifying work processes by utilizing game engine settings for simulating different scenarios. Historically speaking game-based technologies were mainly used within the construction sector for purposes like training workers or providing clients with alternative ways through which they could experience designs visually (De Marco 2022). The gaming engines' increased compatibility with some well-known BIM systems like Unity 3D has also caused a rise in the popularity of merging ideas between these two industries to facilitate realistic environments in video games (De Marco, 2022). Gamification can be done at different project levels i.e., design, build and use. It enhances traditional architectural software by providing immersive experiences, fostering collaboration, enhancing spatial understanding as well as stimulating creativity during the design process (Hamari et al., 2014; Hakak et al., 2019). According to Potseluyko et al. (2022), using a game-like platform alongside BIM may simplify data transfer to a client hence making them more satisfied and leading to increased sales. To improve the collaborative design process,

it is necessary to reach out to users, interact with them, and sustain such engagement over time (Ingvarsson et al., 2023). The project will benefit greatly from the active involvement of participants who may introduce immersive worlds or include people who would not have been brought on board otherwise. This is part of gamification which "gets a person's attention and keeps it" as defined by Kapp (2012:11). It appears that gamification is important from an engagement perspective and designing spaces that can be inhabited by local actors requires involvement (Heravi et al., 2015). When participatory design first used elements of game design (Deterding et al., 2011), it became known as gamification, a concept that is defined by applying competitive challenges and rewards to alter conduct as well as increase involvement (Sanders, 2000; Brandt & Messeter, 2004). Gaming elements can stimulate motivation, interest, and concentration among people more effectively than any other form of teaching aid would do so alone (Leite et al., 2016). Leite et al. (2016) further posit that gamifying tasks makes them less boring or difficult for individuals while at the same time fostering cooperation and social interaction through shared fun experiences. Such an approach has consistently proven successful at boosting staff morale, commitment levels, and overall job performance across various types of organizations (Oke et al., 2023). And Kapogiannis et al., (2020) did thematic analysis. End-users have reported that they were able to enhance their coordination, communication, discussion, and suggestions. Kapogiannis and Sherratt (2018) attributed it to a "collaborative culture." Gamification paired with BIM integration can increase design comprehension. Participants might work together or against each other in other groups or teams for shared objectives. As a result, a sense of community is built leading people to assist each other achieve their goals (Feng et al., 2022; Xiao, 2022). Instead of using BIM alone, immersive spaces can be created through gamification technologies in addition to participatory design. During collaborative design processes, these systems have virtual attributes designed to make shared applications applicable. According to Sanchez et al. (2022), "gamified data model within BIM could offer various capabilities and simulations which can also improve the user experience while giving more detailed design information as well." There are many contexts and design problems that may be helpful by using these strategies like Selin and Rossi (2020). When applied to

certain results, it can reinforce results popular among stakeholders and end users, promote the essence of teamwork, accelerate the design phase, optimize the experience of the users, and increase the level of inclusion, creativity, and innovation. The embracing of virtual, augmented, and extended reality (VR, AR, and XR) technology in business prognoses future trends and radical innovations. If designers wish to meet users' requirements, the solution is an example of an immersive place; anyone capable of engaging in the designing or building process can witness virtual environments and design engaging places (Petrova et al., 2017).

3.1. Future Directions and Developments Through VR, AR, and XR

The traditional use of VR, AR, and XR has proposed a transformative shift in architectural and urban design as stakeholders can be involved in the design and planning processes (Jamei et al., 2006; Sanchez-Sepulveda et al., 2019). Traditionally, architecture and urban planning involve people through conventional consultations, however, integrated design can engage, empower, and enable people and end-users to develop architectural and urban settings (Nabatchi et al., 2015; Wates, 2014). The adoption of VR, AR, and XR in participatory designs presents opportunities for engaging users in design proposal discussions and implementation through visually concrete and interactive environments (Schrom-Feiertag et al., 2020; Rubio-Tamayo et al., 2017). This also could be a result of advancements in technology and an increase in the compatibility of game engines that allows for more research to be done with exploring XR for BIM in recent years (Ng et al., 2023). More and more decision-makers integrate virtual reality into participatory design for architecture and urban design, asserting the need to assess the effectiveness of different forms of VR technology, BIM, and gamification in particular, for a successful and engaging participation as well as overall performance of the design process (Ehab et al., 2023). These technologies can support the co-designing of built environments through different parties and actors creating, planning, designing, and interactively visualizing. How it is beneficial or disadvantageous to implement gamification in BIM, and how it is possible to apply VR, AR, and XR to design realistic environments are also worth considering, as well as the opportunities

and prospective but also together with the limitations and ethical challenges. Examples of gamification within BIM have been discussed in the literature, such as the study by Jamei et al. (2006), where virtual reality (VR) was used to engage stakeholders in a participatory design process. Another example is provided by Sanchez-Sepulveda et al. (2019), who explored the use of augmented reality (AR) in real-time visualization of design options, allowing for immediate stakeholder feedback and adjustments within the BIM model.

3.2. Exploration of BIM and Gamification Integration: An Analysis of Tools

BIM and gamification characteristics provide on the one hand the benefits of each approach to optimize project management, teamwork, and productivity enhancement tools in the construction field on the other hand. This section shares insights on how BIM and gamification can be integrated, examples of technologies, advantages and limitations, cost considerations, and key aspects when implementing this combination.

It ought to be noted that not only has the utilization of gamification and BIM come a long way since their integration in addressing the construction industry challenges in cooperation and engagement but has also delivered intelligent solutions to boost interaction and productivity. The above technologies reveal how the application of gamification in the BIM traditional software could enhance the usability and interactive features of the systems (Table 1). However, these technologies pose certain challenges that accompany them and require further investigation and practice to address in additional studies and projects.

Strengths:

- Enhanced User Engagement: Gamified features like rewards, immersive experiences, and progress tracking keep users engaged and motivated throughout the process.
- Improved Collaboration: Project stakeholders are encouraged to communicate and work together more through tools like Synchro and BIM 360.

Software	Advantages	Disadvantages	Price	Key Elements
BIM 360: A tool that developed by Autodesk for project tracking and performance visualizing that employs gamification techniques to foster engagement and enhance productivity.	It provides thorough tracking and visualization, strengthens accountability and motivation, boosts teamwork, and connects effectively with other Autodesk products.	May be difficult to set up, need a lot of training, and cost more for all features.	Enterprise pricing is available upon request, with starting prices for each user being $480 annually.	Dashboards, document management, issue tracking, award programs, and progress monitoring.
Synchro: As a conceptual utility used in gamifying construction sequences and improving collaboration and planning and currently in its fourth dimensionality, a 4D BIM program.	Increases cooperation, boosts planning and scheduling, detects any problems early, and visualizes the steps involved in building.	High learning curve, potentially costly, and necessitates large data intake.	The annual cost of licensing is roughly $2,000 per user.	Collaborative platform, schedule optimization, problem visualization, and 4D simulation.
Enscape: One of the most basic BIM plugins which makes BIM models for real-time rendering, and virtual reality.	Real-time rendering, immersive virtual reality experiences, enhanced design comprehension, easier client presentations, and early design flaw detection.	Requires VR-compatible gear, may call for a large amount of processing power, and has a higher initial hardware cost.	Begins at $39 per user, each month.	Virtual reality tours, real-time rendering, design representation, and client presentation tools.
BIMobject: There is a platform that has assumed gaming elements with the intent of encouraging people to download and apply BIM objects.	Enhances user interaction, encourages heavy usage of BIM components, and interfaces with different BIM programs.	Not every user will find gamified features appealing, and for optimal benefit, active engagement is required.	Basic access is free, while premium features have a bespoke price.	User awards, accomplishment badges, leaderboards, and a large library of BIM objects.
Buildertrend: One example of a project management program which is used for the incorporation of gamification into tasks, progress, and milestones.	Increases productivity and increases user engagement with processes, visual progress tracking, and task completion reward systems.	It takes time to set up and learn, can be overwhelming for first-time users, and may cost extra for advanced capabilities.	Core features have a monthly pricing of $99, but advanced options come at an extra expense.	Gamification of tasks, visual progress dashboards, tracking of milestones, and user rewards.

Table 1: Comparison of Gamification-Enhanced BIM Softwares.

- **Efficiency and Productivity:** Tools like Buildertrend and BIMobject enhance project management processes, increasing productivity and efficiency.

Weaknesses:

- **High Learning Curve:** Many of these technologies can be tricky to set up and use correctly, and they sometimes call for a lot of training.

- Cost: For smaller organizations, the upfront and ongoing costs of these products may be prohibitive.
- Compatibility and Integration: Ensuring compatibility with current systems and integrating various tools may pose challenges and require a significant amount of time.

Suggested Guideline/Pipeline:

Based on the literature, the following guideline/pipeline could be used as a recommendation for gamification integration with BIM in participatory design:

- First Stakeholder Engagement: Talking about the objectives of the project and creating a participatory framework (Snyder, 2019).
- Gamified Design Sessions: Including stakeholders in the usage of VR/AR tools (Sanchez-Sepulveda et al., 2019).
- Continuous Feedback Loop: Sharpening the study by placing a feedback system (Hou & Rios, 2003).
- Final Review and Adjustments: Improving the design utilizing the information and understanding gained from the gamified sessions (Kapogiannis & Sherratt, 2018).

3.3. Impacts and Benefits

Better judgments are taken, more effective and efficient problem-solving strategies are applied, design alterations are enhanced, and presentation visual quality is increased when these technologies are used in the design process. These technologies have the potential to improve user experiences, offer collaborative design, and interoperability of design and delivery processes, and support various design and building simulations. They can also support information and data visualization, team coordination and collaboration, process monitoring and control, and different designs (Alizadehsalehi and Yitmen, 2021). As a result, immersive spaces are promoted, the project's life cycle is shortened, and the overall cost is reduced. This is accomplished through better planning, more efficient use of resources, and the development of materials, processes, and resources. These technologies are well known for helping professionals and clients engage in more fruitful ways, and game technologies are successful in helping scientists and professionals solve problems. Furthermore, its

application reduces the inefficiencies caused by data and information overload, improving information intake and project understanding. Overall labor costs and project length can be reduced by reducing errors and rework and improving time management (Delgado et al., 2020; Rahimian et al., 2019; Guray and Kismet, 2022). The power of game technology to promote more fruitful interactions between professionals and clients is widely acknowledged. They are also helpful in resolving business and scientific problems. They can be very helpful in decreasing the cognitive workload of workers during various building and assembly tasks and in decreasing the amount of time spent on building component selection and assembly processes and operations by augmenting images and the ambient environment illustrated in the relevant devices (Jetter et al., 2018; Hou et al., 2015; Oke and Arowoiya, 2021). While some studies focused on the use of XR technologies in the project's conceptual stages, others were mainly concerned with how to set up the workstation during construction (Potseluyko et al., 2022). According to Hou et al. (2015:3), using XR during construction and assembly tasks that provide dimension comparison and position determination can greatly reduce the amount of time needed for component selection and assembly as well as effectively reduce assembly errors. Making use of this technology in the design and construction phases can improve information retrieval, collaboration, and communication between various technologies and human and guided channels. By integrating virtual mediums into actual surroundings and imitating prototypes convincingly in real scenarios, workers can obtain valuable knowledge. Employees can see their immediate surroundings and the task at hand more clearly as a result. More precisely, by reducing the amount of time required for task completion, search and reading times, errors and reworks, and physical demands like head and eye movements and mental transformation that are necessary for building and assembly tasks, the use of XR in building tasks and processes improves the productivity/efficiency of the project overall. One way to highlight the main advantage of implementing XR in construction processes is that it will lessen the cognitive burden on employees. As a result, there is a reduction in the overall resource and embodied energy waste, project time and budget, and all the above (Kwiatek et al., 2019; Jetter et al., 2018; Wang et al., 2016; Meki and Lemieux, 2014; Chen and Xue, 2020). Therefore, XR

technology can drastically increase the efficiency of the design and construction industries by reducing the project's overall cost and the amount of time spent on it. What matters more, though, is that they increase the initiative's sustainability. Reducing the amount of labor, rework, energy, and resources used in a project can help lower the carbon footprint and pollution (Delgado et al., 2020; Hajirasouli et al., 2021; Lamptey et al., 2021). Human-Computer Interaction (HCI) has been improved, the end-user experience has been enhanced, and environments have been improved through the integration of technologies through BIM with gamification and Virtual, Augmented, and Extended Reality Technologies, according to research by Kapogiannis et al. (2020) and Stakeholder communications are also improved in small scale constructions and developments.

3.4. Limitations and Challenges

However, promising areas for further investigation of the potential negative effects of employing these technologies and their plugins in BIM and the level of user engagement and participation in designing the building have been identified (Yu et al., 2022; Safikhani et al., 2022). While VR plugins can enrich visualization, it remains disputable how effective they can be for the development of interactive participatory models and for creating engagement (Davidson et al., 2020; Huang et al., 2019). Because plugins have little user interaction, further research is needed to determine how best to apply participatory design, especially regarding stakeholder engagement and involvement.

3.5. Ethical Considerations

Thinking over the problem of using different forms of virtual games and calling it gamification in the formal business world, then the question of participant exposure to the risk of being exploited arises (Leite et al., 2023). Ethics in the context of this work done by Paul and Elder (2003) refers to a set of concepts and principles that help in identifying what conduct fosters or detracts sentient beings. The use of gamification in the workplace comes with some ethical issues and hence deserves some lending of the ear. The potentially negative effects of wrongdoing in gamification include the creation of competition between co-workers, which could potentially lead to demotivation of the workers if intrinsic motivational tools replace the external ones (Korn & Schmidt,

2015). From the study by Korn and Schmidt (2015) on gamification in the marketing field, this technique has been applied to screen and fire underperformers in organizations. Thus, it implies that while applying the concept of gamification, certain precautions should be taken to avoid the situation which can turn into a dangerous pressure cooker where the employees' positive emotional and social experiences at work could be overshadowed with negative shading, or into useful means for the change of the climate in the team and employees' engagement (Shahri et al., 2014). According to Thorpe and Roper (2019) in their study regarding ethics in marketing use of gamification, they put a stress point on the criteria utilized as the basis for defining the specific relating to social responsibility, honesty, and truthfulness which all participants must follow. We can also argue that strictly speaking, people who advocate gamification are not interested in inflicting physical, let alone psychological, pain upon their fellow man. Chou (2015) states that for a gamified system to be considered ethical, it needs to fulfill two essential requirements: first, it is necessary to inform completely about the purpose of such functioning; secondly, the user should agree with the given kind of service. While it is significant that Marczewski (2017) stressed the importance of ethical aspects to be taken into concern when designing gamified systems, it is important to see that the two pillars of ethical issues in gamification are Transparency and Permission. To elaborate on the ethical issues surrounding the gamification of education, O'Sullivan et al. (2021) argue there is a need for moderation of aspects that may tactfully invite manipulation leading to the abuse of the tool. As per the ethical implications of engaging customers through gamification in interactive marketing, Al-Msallam et al. (2023) pointed out that it is high time to be significantly applied to avoid negative outcomes. Conversely, Kim (2015) in the analysis of misevaluation, seeks to identify the moral strategies that the ''users'' are exploited or manipulated, and the author strives to protect the ''user'' autonomy and well-being. Drawing from their literature on ethical objectives of gamefulness in healthcare, Coelho and Reis (2021) further make a big emphasis on the significance of stakeholder engagement to enhance moral conduct. There is presented a detailed overview of gamification ethics by Hyrynsalmi et al. (2018) who state that moral challenges are a critical factor in designing and implementing gameful systems. The identification of

participatory design with game-centered design raises questions on various ethical concerns linked with data acquisition, protection, and tracking. It is not unusual for gamified elements to rely on sophisticated data acquisition mechanisms to acquire data and patterns from the users to achieve increased levels of user engagement and active participation. But these are procedures that require additional careful consideration of the ethical consequences. Since gamification involves making users engage in positive behaviors, they must be tracked to revisit the same action. While such data collection can increase efficiency and individualization, concerns arise regarding consent, transparency, and potential discretionary use. While there are benefits, the rights associated with participants, including their privacy, may be compromised if users are not always fully aware of how much data is being collected or used (Marreiros et al., 2016). In addition, the collection and analysis of personal information and data make individuals more susceptible to discrimination and manipulation if proper measures are not implemented. Additional ethical issues come to light if the effectiveness of the created gamified systems includes such elements of control. Regardless of whether they are implicit or hidden, surveillance approaches can pose risks that undermine user liberty and create default suspicion. Besides, the intimidation perceived through surveillance may have feelings such as compliance and self-policing, which translates to a lack of genuine involvement and cooperation in participatory design processes. Hence, to reduce measurable threats and to sustain user trust, significant consideration must be provided to the rationale, proportionality, as well as perimeters of overseeing tactics. Concerning gamification, as well as participatory design, privacy, emerges as a critical concept not only because of the protection of data but individual freedom as well. These are theoretically excellent but practically perilous due to several factors such as the use of gamified systems and large data traffic, which inevitably raises the risk of violations of privacy and unauthorized access (Felt et al., 2016). Namely, when their data are shared without their permission or utilized for algorithmic profiling, people feel forced and endangered. The application of effective technical barriers, openness of the privacy rules, and user control solutions are the requirements for privacy preservation. Ethical concerns involving data gathering, surveillance, and privacy in gamification and participatory

design, where the values of innovations are juxtaposed with accountability, bring out the importance of balancing the two. These principles can be realized by practitioners so that ethical engagement and cooperation are achieved effectively via priority given to the aspects of transparency, permission, and user-oriented empowerment. However, real, and continuous monitoring and discussion are required to address new ethical concerns and ensure that gamified systems maintain the foundational principles of justice, respect, and dignity.

4. CONCLUSION

In many aspects, it may be considered that the use of game design elements coupled with Building Information Modeling (BIM) becomes a transforming moment in today's design practices, it has the potential to become revolutionary in terms of creating immersive environments and fostering collaboration in team projects. By incorporating such mechanics into the learning and design process, resolution of the challenges, and decision-making in scenarios with the help of simulations, for example, stakeholders are enabled to engage in the practice of participatory design for diversity, creativity, and innovation. This collaborative approach stresses the processes for the design of the physical deliverable, fabrication, and construction that yield improved value for the client and the stakeholders, reduce project costs, and deliver optimum value. This is enhanced by tools like BIM 360, Dalux, Synchro, & Enscape, BIMobject, and Buildertrend. Extension of reality in VR, AR, and XR technologies enhances the complexity of design environments by reinforcing actual-like settings and concurrently helps stakeholders engage more due to combined reality and virtual reality experience. Nonetheless, the complex ideas about ethics on data protection, equality, and emergent consequences must be paid much attention in the construction of gamified BIM systems. Meanwhile, to fully realize the potential of gamified BIM environments, designers must be willing to apply changes in ethical approaches and technological advances to counter these challenges. This includes incorporating robust data protection measures for gamified interactions, ensuring data contributed by users is competent and that rewards coupled with punishment are balanced, and fundamentally eradicating unpredictable consequences by organizing detailed risk assessments and contingency measures. Engaging experts across a

variety of fields to participate in design and technology decision-making can serve to provide insights and approaches for navigating the complex ethical realities of gamified BIM environments. Designers may fully capitalize on gamified BIM settings to construct convincing locations that would ultimately blend actual and digital worlds into a singular setting and could apply these concepts and practices to meet the different objectives and goals of every stakeholder involved. The reconnaissance of optimistically configured BIM settings could be realized through gradual improvements and organic innovation; the new paradigm of social, Integrated designs may well be on the horizon as BIM opens the door to including and enhancing the pleasures of pro-developmental creations and innovations.

Recommendations for Future Studies:

- User-Centric Design: The goal of future research should be to lower the complexity and learning curve of these technologies to make them easier to use.
- Cost-Benefit Analysis: To offer more precise Return on Investment (ROI) information, studies ought to assess how cost-effective certain solutions are in different project scenarios.
- Integration and Interoperability: It is possible to increase the usefulness and usability of various BIM and gamification solutions by creating standards for improved integration and interoperability.
- Ethical Considerations: To guarantee that these tools are used appropriately, it is imperative to conduct an ongoing examination of the ethical implications of gamification in professional settings.

Gamification and integration with Building Information Modeling (BIM) offer a practical solution to enhance collaboration and project management in the construction industry. Tools like BIM 360, Dalux, Synchro, Enscape, BIMobject, and Buildertrend demonstrate how incorporating gamified elements can boost user engagement, efficiency, and productivity. Although these technologies have many benefits, like enhanced productivity and a better user experience, there are drawbacks, like a somewhat steep learning curve and compatibility problems. To effectively benefit from this integration, user-centric design approaches such as participatory design must be prioritized in future studies and projects. It is crucial to involve end users in the development process, carry out exhaustive cost-benefit evaluations,

guarantee seamless integration and interoperability, and handle persistent ethical issues. By addressing these issues, the construction sector may better stimulate innovation and enhance project outcomes by utilizing the benefits of BIM and gamification. It's critical to recognize that there are many moving parts involved in realizing the revolutionary potential of gamified BIM environments. It calls for an all-encompassing approach that considers technological innovation, ethical considerations, and interdisciplinary collaboration. Through cautious handling of these problems, designers might build a future in which immersive and participatory design methods enable stakeholders and mold the built environment to fulfill societal expectations.

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