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Driving Research and Innovation for a Smart Built Environment*

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THE ROLE OF ACTIVE DESIGN IN PROMOTING PHYSICAL ACTIVITY THROUGH TECHNOLOGY-DRIVEN ENVIRONMENTS IN MALAYSIA

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Abstract

The increasing reliance on technology-driven activities among young people has contributed to a decline in physical activity, raising concerns over sedentary lifestyles and associated health risks. In response, this study explores the integration of active design strategies within technology-driven environments to promote physical engagement. The research aims to identify key active design principles, assess their implementation in existing technology-based recreational spaces, and propose an enhanced architectural framework to foster physical activity. A qualitative approach was adopted, including literature analysis, observational studies, and comparative evaluations of two exergaming centers in Malaysia—The Rift and Battle Arena. Findings reveal that while these centers incorporate interactive gaming elements, they lack comprehensive active design strategies that seamlessly integrate movement with spatial engagement. The study proposes an active design framework that enhances circulation patterns, spatial organization, and interactive elements to encourage sustained physical activity. The implications of this research extend to architects, urban planners, and policymakers, offering insights into creating technology-driven environments that support healthier lifestyles. By merging active design principles with digital entertainment, this study contributes to the development of innovative, movement-oriented recreational spaces that align with contemporary lifestyle trends.

Keywords: (active design, exergaming, technology-driven activities, sedentary behavior, youth engagement)

1. INTRODUCTION

The rising prevalence of obesity and overweight issues among Malaysian youth has become a serious health concern, with a projected increase in childhood obesity cases to 1.65 million by 2025. High levels of screen time are associated with reduced physical activity, as time spent in front of screens displaces opportunities for active behaviors (Tremblay et al., 2024; You & Cui, 2024). Exergames provide a high level of motivation and user engagement by combining physical exercise with interactive technologies. This approach is particularly effective for children and adolescents who may struggle with traditional forms of exercise due to challenges with motivation and impulse control (Shynkaruk et al., 2024) (İçen, 2024). Spatial design contributes to the immersive quality of exergames, making them more engaging and enjoyable for users ("The Role of Spatial Design in Implementing the Immersive Experience of Gaming Quest Rooms", 2023). This study focuses on the application of active design strategies in technology-driven environments to enhance physical activity, aiming to develop a framework that integrates movement-based interactions within gaming spaces in Malaysia.

2. LITERATURE REVIEW

Exergaming has been shown to increase energy expenditure compared to traditional sedentary video games, making it a healthier alternative (O'Loughlin et al., 2020) (O'Loughlin, 2019). The gamified nature of exergaming can enhance intrinsic motivation, leading to sustained participation in physical activities (O'Loughlin, 2019) (Shynkaruk et al., 2025). Many exergaming programs incorporate social elements, fostering teamwork and community engagement, which can further motivate youth to be active (Shynkaruk et al., 2025).

The built environment plays a crucial role in influencing human behavior and physical activity. Environmental psychology suggests that spatial organization and design impact how individuals interact with their surroundings (Ittelson et al., 1974; Mahmoud, 2020). Key urban design principles such as density, diversity, and design significantly affect physical activity levels (Pinter-Wollman et al., 2018). The Active Design Guidelines emphasize the importance of circulation systems, building elements, and spatial organization in promoting movement (Centre for Active Design, 2010).

Additionally, Self-Determination Theory (SDT) highlighted the role of intrinsic motivation in encouraging physical activity. The theory suggests that individuals are more likely to engage in physical movement when their competence, autonomy, and social connection are fulfilled (Ryan & Deci, 2017). Studies have shown a strong correlation between SDT, built environments, and increased physical activity, emphasizing the need for well-designed spaces that encourage movement (Gay et al., 2011; Silva et al., 2010). By integrating active design principles, exergaming, and SDT, this study aims to develop an effective framework for enhancing physical engagement in technology-driven environments, addressing concerns about sedentary lifestyles among youth.

3. METHODOLOGY

This study utilized a three-stage qualitative approach: (1) a literature review to establish active design principles, (2) qualitative observation and comparative analysis of The Rift and Battle Arena using eleven parameters, and (3) translation of findings into an architectural design proposal to enhance physical engagement in technology-driven environments.

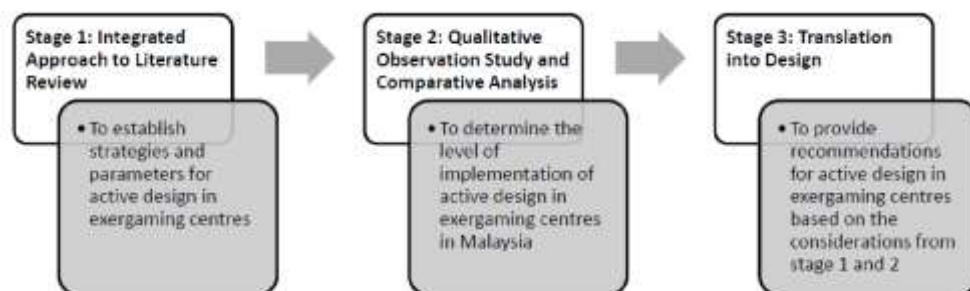


Figure 1. The Research Direction
 (Zaharin et al., 2020)

The study focuses on sedentary technology-driven spaces, which differ from conventional active environments. There is limited precedent and evidence regarding the integration of digital technology in gaming and exercise within the local context. Additionally, the analysis of physical activity in buildings is primarily based on spatial experience and observational assessments.

4. FINDING AND DISCUSSION

The study found that technology-driven recreational spaces, such as The Rift and Battle Arena, provide interactive gaming but lack comprehensive active design strategies to promote physical movement. The Rift, featuring exergaming and virtual reality, supports more active engagement, while Battle Arena remains largely sedentary.

Key issues identified include poor circulation, limited spatial interaction, and restricted movement opportunities. The comparative analysis showed that current exergaming centers do not fully utilize spatial configurations to encourage physical activity. Elements such as building layout, circulation, and active spaces have a significant impact on user engagement.

To bridge these gaps, the study proposed an active design framework focused on movement-friendly planning, interactive architectural elements, and dynamic circulation systems. This approach aims to transform technology-driven environments into more engaging, physically active spaces. The findings show the importance of holistic design that aligns digital entertainment with health-focused, movement-oriented experiences, encouraging long-term behavioral change among users.

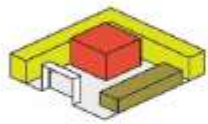
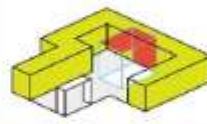
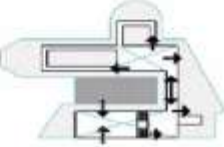
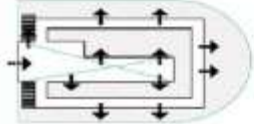
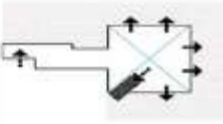
ACTIVE PROGRAM	eSport Arena	The Rift	Battle Arena
BUILDING STATEMENT Interdependency state of the building shall determine the overall building statement.	An independent building with its facilities - hence the industrialised statement is very bold internal and externally. These features allow the drop off to be well covered and integrated. Transparency permits the buildings to showcase its programs to the public.	Attached facilities to a shopping mall - hence design statement of virtual theme is seen in the internal area and the entrance. As a theme park, surprising elements and attention grabber programs are placed right at the entrance hall.	An attached facility to a shopping mall - hence design statement with a battle theme is seen within the circumscribed area. However, its generic entrance features are meant for a specific target group, i.e. gamers.
BUILDING SPACES Organisation of major program shall translate the active design features of the building.	 The major program is positioned at the end of the block. Active design features are translated as the thematic narrations from the entrance to its final attraction.	 The major program is positioned at the centre and hidden from its user. Active design features is translated in its sense of curiosity experience .	 The major program is positioned at the centre and high invisibility. Since most of the programs are in a sedentary state, active design features are translated in its atmospheric theme .
Circulation: Circulation of active design shall be translated through different movement that generates overall building organisation.	 Combination of centralised and radial movement. Three central nodes (with specialised courtyard) indicates three zoning area - public semi public and private zone. Radial movement enhance thematic narration into every program.	 Combination of centralised and radial movement. One central node disperses into a one loop radial movement full with curiosity and surprising elements along the narrow path.	 Focusing on centralised movement where the main program become the epicentre that enhance specific atmospheric theme.
BUILDING ELEMENTS Enhancement of activities through Building Elements. In line with the active design parameters, every programs are structured based on three pillars of active design relationship model. Thus, the programs shall promotes physical activity through different environment that initiates self determinants. Hatches at three-sided blue cube indicates the level of engagement with its user.	POD - Sedentary state  POD 2 - High engagement  RACING - High engagement  MAZE - High engagement  ADVENTURE - High engagement 	POD - Sedentary state  POD 2 - Low engagement  HURRICANE - Low engagement  HOLLOWALL - Medium engagement  ZERO LATENCY - High engagement 	POD - Sedentary state  ARENA - Low / Medium engagement 

Table 1: Comparison of active design strategies between The Rift and Battle Arena (Zaharin et al., 2020)

5. CONCLUSION

This study highlights the potential of active design strategies in enhancing physical activity within technology-driven environments. Findings indicate that current exergaming centers, such as The Rift and Battle Arena, lack a comprehensive approach to integrating movement-based design elements. By proposing an active design framework, this research demonstrates how spatial organization, circulation patterns, and interactive architectural features can foster physical engagement. The study emphasises the importance of aligning technology-driven recreational spaces with active living principles to combat sedentary behavior among youth. Future research should focus on the long-term effectiveness of active design interventions and their broader applications in urban planning and facility design to promote healthier lifestyles.

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