



## The Implementation of Active Design for Technology-Driven Activities in Malaysia

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### Abstract

The youth nowadays focused more on electronic media technologies, which resulted in a decrease in physical activities and growing health problems. In combating this dilemma, exergaming is introduced. However, it needs to be incorporated with the environmental surrounding to be proactive. This paper intends to investigate the potentiality of implementing the active design strategy in technology-driven activities in Malaysia. The findings from existing exergaming case studies are synthesized into a design strategy and translated to an architectural proposal. In conclusion, the active design strategy is significant in integrating environmental, physical and human needs and developing quality active living amongst youth.

Keywords: exergaming; interactive; physical activity; active design

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### 1.0 Introduction

The prevalence of obesity and overweight has become a severe health problem in Malaysia. Obesity and overweight are often associated with a higher risk of non-communicable diseases (NCD) such as cardiovascular disease, metabolic syndrome and diabetes. According to the survey conducted by the National Health and Morbidity Survey (NHMS) in 2015, the risk factors of NCD are continuing to rise. The findings estimated that 3.5 million adult Malaysians are living with diabetes, 6.1 million with hypertension, 9.6 million with hypercholesterolemia and 3.3 million with obesity. The survey also shows that 11.8 per cent of children and adolescent in Malaysia below 18 years of age are obese, and there is a projection that this figure will increase to 1.65 million by 2025. In similar findings by Wan Mohamed Radzi et al. (2019) on the analysis of obesity among the Malaysian Public University Students, 21.2 per cent of the students are overweight, and 16.3 per cent are obese.

Many factors that contribute to obesity and overweight. The study conducted by Mohd Samsudin et al. (2019), and Chan et al. (2017) suggests the influence of obesity and overweight by the decrease in physical activity, increased in sedentary behaviour, unhealthy eating habits, alcohol intake, socioeconomic conditions and genetic factors.

One of the reasons that lead to sedentary behaviour among the younger generations is the excessive use of digital media for entertainment. Dirandeh et al. (2015) conducted a study on the effect of video games on teenagers' behaviour and performance. The results show that almost all of the teenagers were interested in playing video games, with 76.8 per cent of them played video games once in a while. The motivation behind the use of video games was excitement and amusement. The teenagers also tend to overeat when they spent more time playing video games.

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In view of the 11th Malaysia Plan, the Ministry of Health, Malaysia established The National Strategic Plan for Non-Communicable Disease (NSP-NCD) (2016-2025) to reduce the risk factors of NCDs and to provide the necessary preventive measures. The strategic plan has five (5) main objectives which comprise of the response for prevention and control of NCDs, reducing the risk factors for NCDs and the underlying social determinants by promoting healthy environments, to strengthen the health systems through people-centred primary health care and universal health coverage, to promote and support high-quality research for NCDs and to monitor the trends and determinants of NCDs and evaluate the preventive measures and control.

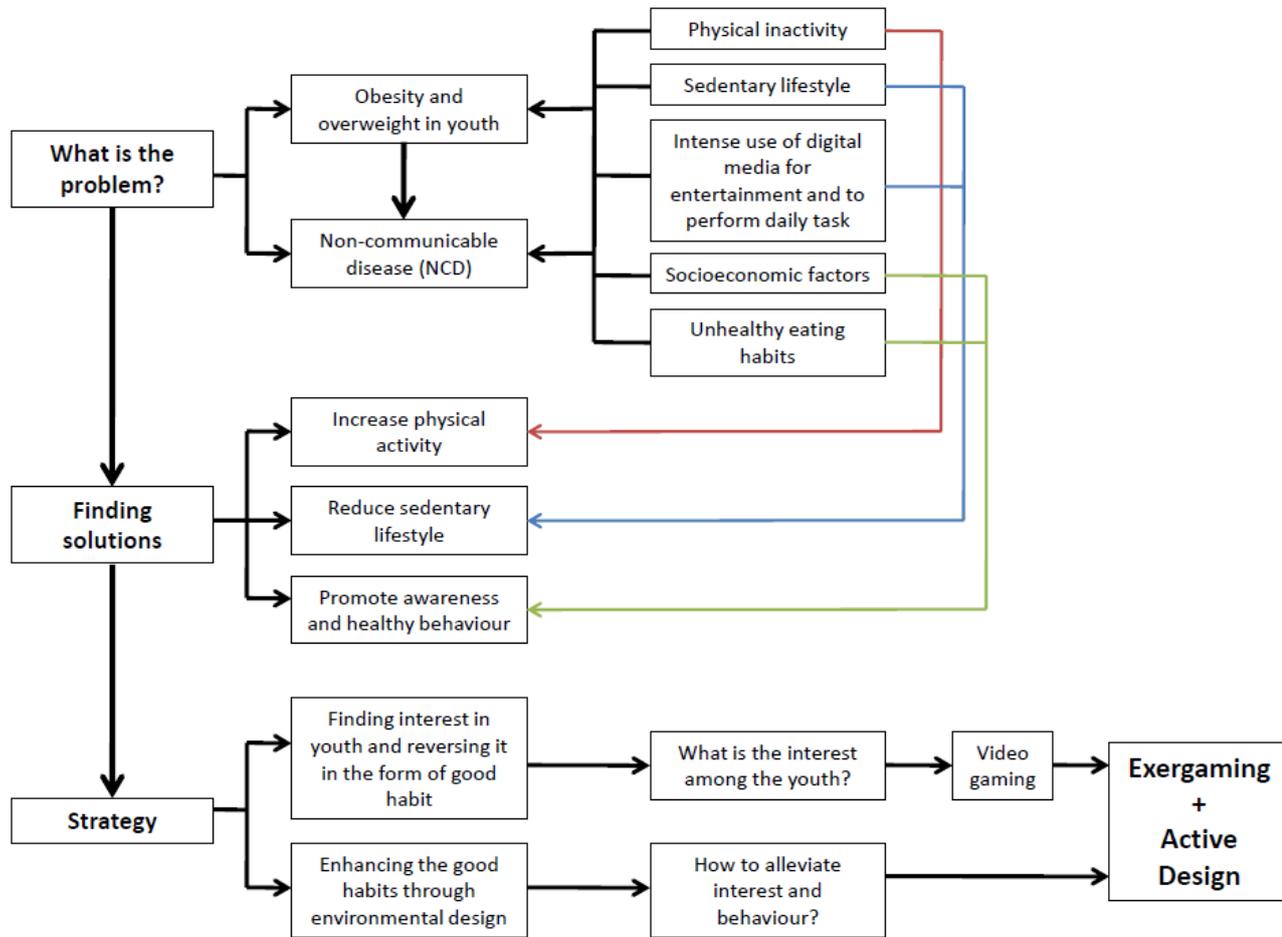


Fig. 1: The Mapping of Obesity and Overweight Problem-Solution  
(Source: Author)

As such, this paper intends to investigate the potentiality of implementing the active design strategies in technology-driven activities in Malaysia in enhancing the level of physical activities and health among the younger generations. Consequently, the objective of this paper is as follows:

- 1) To review and establish active design strategies for technology-driven activities in Malaysia
- 2) To determine the level of implementation of active design in technology-driven activities in Malaysia
- 3) To translate the application of active design strategies into a new architectural design of technology-driven activities in Malaysia

## 2.0 Literature Review

### 2.1 Technology-Driven Activities: Exergaming

Technology-driven activities such as screen-based entertainment have become a potential habit among the younger generations. Despite its criticisms on the excessive use of technology which can be a potential source of cardiovascular disease (CVD), this can be reversed to develop good habits.

Exergaming or active video gaming is a form of digital games that require bodily movements to play and stimulates an active gaming experience that can function as a form of physical activity (Benzing and Schmidt, 2018). It relies on technology to create and enhance physical movements and actions. Baranowski (2017), identified children and adolescents as a group who will have special interests in and benefit from exergames due to their level of enthusiasm towards video games.

Lamboglia et al. (2013) conducted a pilot study on the effect of active video games towards physical activity in children. The participants were randomised to play either active video games (Eye Toy and dance mat) or conventional sedentary games. Measurement was conducted using an accelerometer. The findings which were gathered after 12 weeks of experimentation show that the children in the intervention groups displayed higher levels of physical activity. The study suggests that technology may be viewed as an effective strategy to encourage an active lifestyle and healthy behaviour. It also acts as an aid to fight against childhood obesity. However, exergaming tends to cause strain injury and intermuscular disorders.

## **2.2 The Influence of Built Environment on Human Behaviours**

The behaviour and well being of an individual is highly influenced by the built environment. In environmental psychology, a person perceives the surrounding environment through the geographical environment, the interactive environment, the aware environment and the behavioural environment (Ittelson et al., 1974). In architecture, besides the shape and form of the building, the physical aspect of creating spaces have an impact on the personality of the inhabitants and the interaction between the users and its surroundings (Mahmoud, 2020). According to Pinter-Wollman et al. (2018), there have been numerous efforts in recognising the impacts of built environment towards physical activity. The environment features that influence the physical activity at the urban or neighbourhood scale can be seen through the '3 Ds' which include density, diversity and design. On the building scale, there are four (4) key themes that can help to promote physical activity. These are building circulation system, building elements, organisation of the building program and activity spaces. The design should also consider the aspect of self-engagement towards physical activity rather than obligatory.

## **2.3 Active Design**

### **2.3.1 The Concept**

Active design, according to the Centre for Active Design, New York, is an approach that integrates physical activity in the building, landscape or urban design solutions to promote healthy communities. The process of active design involves four (4) key concepts which include greater physical movement in buildings, provision of recreational spaces that are accessible to all in cities, transportation systems that encourage physical movement and living healthier through food and healthy eating environments. Based on the Active Design Guidelines established by the City of New York in 2010, the creation of active-friendly buildings is much dependent on the integration of the active design philosophies into the building program and the building circulation system. The guidelines recommend four (4) key opportunities in designing active buildings which include proper consideration of building circulation system, integration of design elements that can deter physical activity, organisation of building program that promotes physical movement and allocation of activity spaces that can enhance physical activity.

### **2.3.2 The Efficacy of Active Design**

Tannis et al. (2019) conducted a study among residents living in active design buildings and non-active design buildings to determine the effects of active design towards their physical activities. The study suggests that the implementation of active design in buildings has an influence on the behaviour change and can positively impact the usage of stairs among the residents. However, the enhancement of physical activities needs to be strongly supported by high self-rating of health, self-efficacy and good community engagement, social support and networks. The survey also put forward to older adults being more concern in physical and psychological health issues as compared to younger participants.

In a different study conducted by Engelen et al. (2016), a survey was carried out among participants from 25 to 45 years of age to ascertain the health behaviour and perceptions in an active design workplace. Part of the active design strategies implemented in the workplace is stair use promotion, provision of exercise facilities, pedometer walking programmes, open plan concept and sit-stand desks. The study concludes that active design brings a positive effect on healthy behaviour with the reduction of sitting time and increase in standing time. The design also provides more opportunities for incidental activity and is perceived more stimulating among the users. However, the findings also show that there is no significant increase in the walking time, the number of stairs climbed and self-rated quality or quantity of work among the workers.

## **2.4 Self-Determination Theory (SDT)**

### **2.4.1 The Concept**

Self-determination is a concept that enables people to feel in-control in making choices and managing their life. It relates to the motivation of taking actions based on their innate feelings to obtain desirable outcomes.

In self-determination theory (SDT), people are motivated to become self-determined by three innate or intrinsic values and universal psychological needs which include competence, connection or relatedness and autonomy. The need of competence relates to having the appropriate skills for success by seeking control of the outcome while the need of connection or relatedness highlights the will and desire to experience social attachment and a sense of belonging. The need for autonomy focuses on self-directing freedom and moral independence in achieving goals. According to Ryan and Deci (2017), SDT assumes that humans tend to be curious, physically active and deeply social beings. SDT gives concern towards individuals proactive capabilities in engaging, interpreting and taking actions based on the nature of the external environments.

### 2.4.2 The Relationship between SDT, Physical Activity and Built Environment

A survey conducted by Gay et al. (2011) suggests that there is a significant relationship between physical activity, built environment and the universal psychological needs of competence, connection or relatedness and autonomy. The participants of the survey were adults recruited from a weight loss program in South Carolina, USA. The survey consists of three (3) main components which include the Godin Leisure-Time exercise questionnaire, basic psychological needs in exercise scale and perceptions of the built environment. The findings show a positive relationship between SDT and physical activity behaviour, a strong correlation between neighbourhood characteristics (built environment) and physical activity behaviour and significant interaction between neighbourhood characteristics (built environment) and SDT. The study concludes that the built environment has an impact on the relationship between physical activity behaviour and SDT.

In another study conducted by Silva et al. (2010), SDT was used to promote physical activity and weight control in women. The participants were female between 25 to 50 years of age, recruited through media to enrol in the behavioural weight loss program. The program was grounded based on the SDT intervention that promotes an autonomous form of exercise and intrinsic motivation. The results suggest that the weight loss program with an intervention of SDT has a strong influence on the physical activity behaviour among the participants, thus help in the process of weight reduction.

## 3.0 Methodology

The study is conducted in three (3) stages, as highlighted in Fig. 2. The first stage is the integrated approach to literature review followed by the qualitative observation study and comparative analysis in the second stage. The third stage involves translation into design.

### 3.1 Stage 1: Integrated Approach to Literature Review

The research questions were established to determine the scope and direction of the literature review. The questions consist of the followings:

1. What constitutes the major health problems in youth today?
2. What are the factors that contribute to the significant health problems in youth today?
3. What are the significant habits among the youth, and why is it a problem?
4. How can we overcome the problem? What are the measures that we need to take to solve or reduce the problem?
5. Is there any existing research conducted in finding solutions to the health problem in the form of the active design model, framework, strategies or guidelines?

The content of the literature review was analysed and synthesised. The collective measures, strategies, policies and guidelines were reviewed and evaluated to provide a basis for building a new conceptual model and strategies.

### 3.2 Stage 2: Qualitative Observation Study and Comparative Analysis

The conceptual model and strategies established in stage 1 are developed into parameters that are used to conduct the qualitative observation study and comparative analysis. There are eleven (11) main parameters to be examined. These parameters fall under four (4) main guiding principles which include the building program, building statement, building spaces and building elements. Observation is conducted using these parameters at two (2) technology-driven activity centres in Malaysia; (1) The Battle Arena in Petaling Jaya and (2) The Rift in Kuala Lumpur. Battle Arena is the biggest e-Sports Centre in South East Asia with an area of 17,000 square feet and can accommodate up to 400 people. The Rift is the most substantial local virtual reality and augmented reality (VR/AR) theme park in Malaysia, which highly promotes exergames. The findings from these two (2) exergaming centres are compared and analysed to determine their level of implementation of active design.

### 3.3 Stage 3: Translation into Design

Stage 3 involves the translation of data obtained from stage 1 and 2 into a new architectural design for technology-driven activities. The proposal considers the strengths and limitations of the findings and provides recommendations to enhance the level of implementation of active design in exergaming centres.

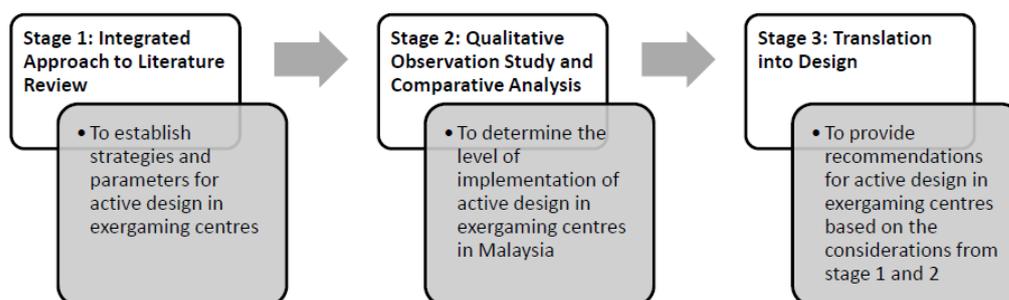


Fig. 2: The Research Direction  
(Source: Author)

### 3.4 Limitation of Study

The study is conducted on sedentary technology-driven space which differs from the generic active space. There is a lack of precedence and limitation on the evidence of the use of digital technology in gaming and exercise in the local context. Furthermore, the analysis of the physical activity in buildings is conducted based on spatial experience and observation.

## 4.0 Findings

### 4.1 Active Design Relationship Model

Fig. 3 illustrates the relationship between the active design model. The model emphasises on the three (3) pillars of interrelationship that link to the physical activity behavioural change. In this model, the environment plays a significant role in determining the psychological behaviour of building user. It gives the perception of oneself towards the building space and its surrounding. The right content and conducive environment provide opportunities for building users to engage in physical activities. Environmental factors also influence the innate and intrinsic values of an individual that can lead to self-satisfaction, self-control and meaningful interaction and relationship between humans and its surrounding. Strong self-determinant and well-perceived environment help to stimulate a sense of autonomy and persistence towards physical activity.

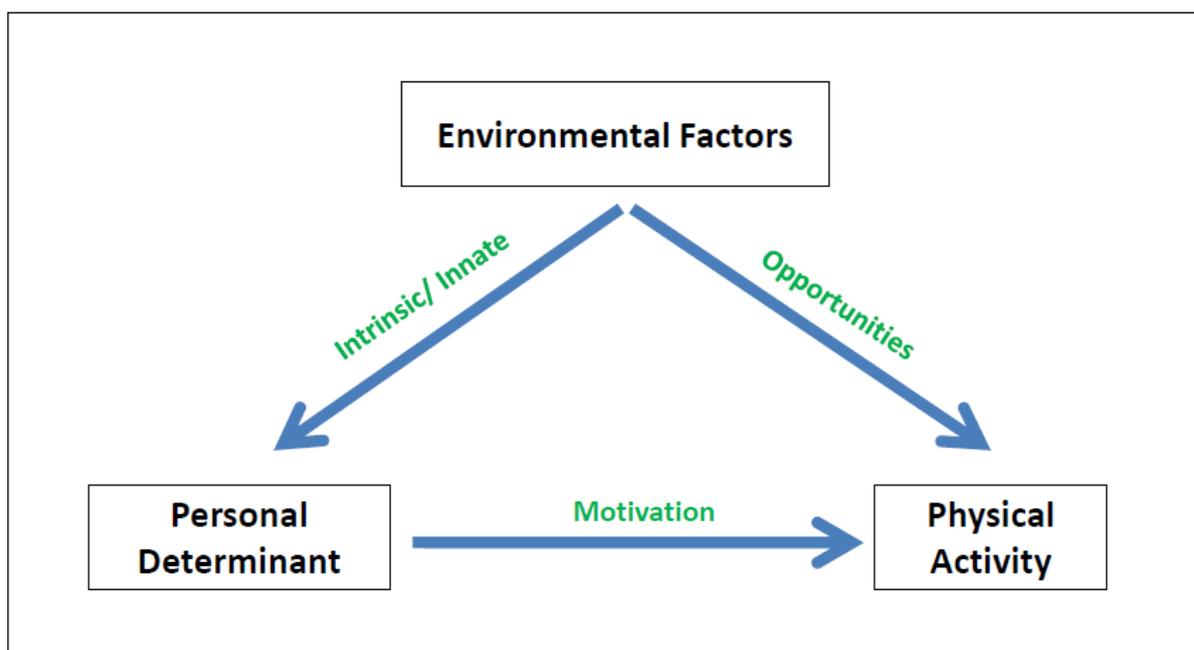


Fig. 3: The Active Design Relationship Model  
(Source: Author)

### 4.2 Active Design Framework

Fig. 4 highlights the formation of the active design framework. It involves the translation of the active design relationship model into four (4) main guiding principles which include the building program as the domain variable and the building statement, building spaces and building elements as the sub-domain variable. The building program describes the entity of the building, and it differs from one building to another in terms of its function and activities, building statement, building spaces and building elements. The guiding principles become the basis for outlining the strategies for active design. The Active Design Framework highlights eleven (11) main parameters which act as a guide for design direction in motivating self-determinant and supporting physical activities and social interaction.

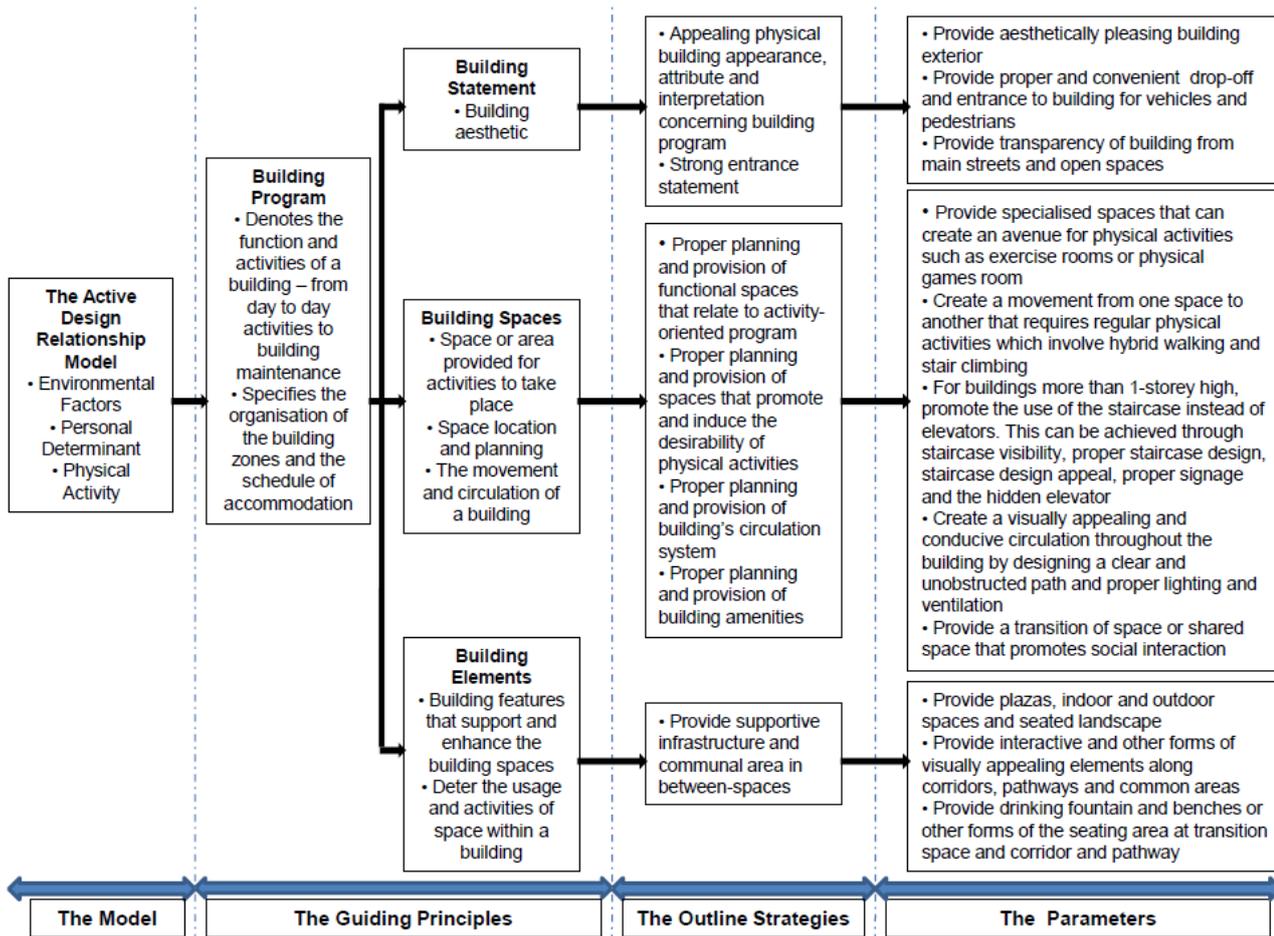


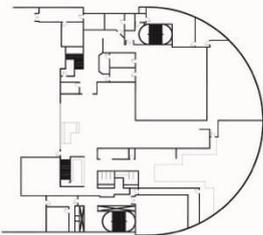
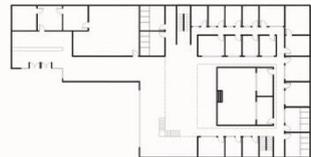
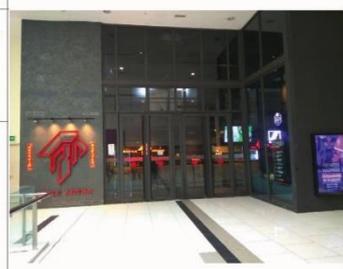
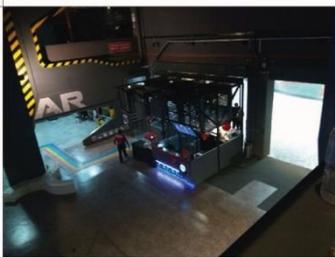
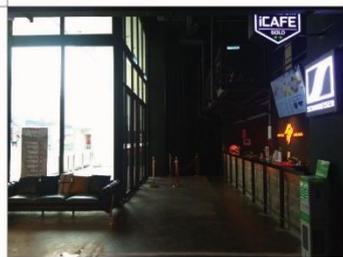
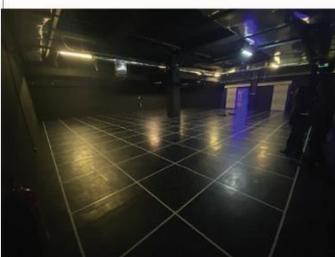
Fig. 4: The Active Design Framework (Source: Author)

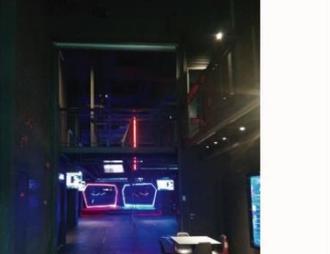
### 4.3 Comparison between The Rift and Battle Arena

Table 1 indicates a comparison based on the established active design framework of two (2) exergaming centres in Malaysia, namely The Rift and Battle Arena. Based on the building program, The Rift has demonstrated hybridity of active programs as compared to sedentary games in Battle Arena. These conditions have profoundly effected their building statement of indoor and outdoor aesthetic. As both centres display unique architectural themes, they project a disparity in the level of transparency. The Rift is externally visible and welcoming while Battle Arena is internally connected. In terms of building spaces, The Rift is constructed with multiple enclosed programs and narrowed passage, hence allowing for potential independent exergaming venues. As venues are separated, the passageway is furnished with exciting elements and props to convey the concept. However, in Battle Arena, due to its high degree of open spaces and wide circulation area, the central arena act as the most potential and flexible venues of exergaming. This massive area is equipped with generic building elements of seatings and transitional spaces.

Table 2 shows the translation of active design framework into an architectural proposal. Known as eSport Arena, this facility aims to provide an enhancement of active design through a combination of exergaming, educational and research activities. The building programs are focusing on human senses and experience, starting from one-to-one pod to physical environmental engagement technology. High-tech concept and futuristic design highlight most of its programs and this condition has influenced the overall building statement internally and externally. The high degree of transparency through an integrated specialised courtyard allow for greater visibility and connection of building spaces. This strategy permits flexible circulation with transitional interactive areas, hence creating more active potential exergaming venues within the building.

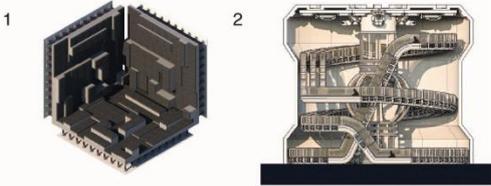
Table 1: Comparison of active design strategies between The Rift and Battle Arena

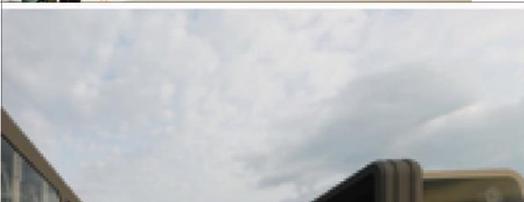
ACTIVE PARAMETER		THE RIFT	BATTLE ARENA
BUILDING PROGRAM	What is the main function and activities of the building?	Function as a VR/AR indoor theme park located in the Mid Valley Megamall Kuala Lumpur. Currently, this facility is the largest of its kind in the nation. It is aiming to demonstrate the best virtual/augmented reality technology, promoting esports industry and facilitating venues for events.  Programs are: Zero Latency / Terminator X / EXA Dimension 12 / HADO / Raceroom / Hurricane VR / Holowall / Motion Blaster / Sandbox / Run the River	Currently holding as Southeast Asia's biggest esports club, this facility aiming to provide a supportive environment for gamers by offering the highest-level technology of gameplay, and setting up new awareness towards esports and its career path. It also seeks to facilitate venues for events.
	How are the spaces planned or programmed?	Spaces divided into two levels based on the programs. The micro supportive program surrounds the main attraction via loop oriented corridor. 	All programs are designed in <b>centralised organisation</b> . The main attraction act as an open central arena, surrounded by supportive program in cubicle spaces. 
BUILDING STATEMENT	Provide aesthetically pleasing building exterior.	Welcoming & attractive exterior for the public. 	Exclusive & attractive exterior - meant for certain public group. 
	Proper and convenient drop-off and entrance to building for vehicles and pedestrians	Part of shopping complex attraction - shared drop-off and entrance facilities.	Part of shopping complex attraction - shared drop-off and entrance facilities.
	Provide transparency of building from main streets and open spaces	Most of the programs are in the enclosed space. Only main public area with attention grabber games are open. 	All spaces are open and transparent. 
BUILDING SPACES	Allocation of specialised spaces that can create an avenue for physical activities such as exercise rooms or physical games room	The main attraction is designed based on an open concept and flexible to any related physical activities. 	The main attraction allow limited physical activities due to huge installation stage for games tournament event. 
	To create a movement from one space to another that requires regular physical activities which involve hybrid walking and stair climbing	Movement in within spaces are integrated with special effects that encourage consistent walking or hybrid physical engagement. 	Movement in within spaces encourage only normal walking and resting area. No climbing or any hybrid physical activities allowed. 

ACTIVE PARAMETER	THE RIFT	BATTLE ARENA
<p>For buildings more than 1-storey high, promote the use of staircase instead of elevators. This can be achieved through staircase visibility, proper staircase design, staircase design appeal, proper signage and the hidden elevator</p>	<p>Staircase becoming part of the loop circulation. Users are forced to move through it to complete the entire VR/AR programs.</p> 	<p>Staircase is very bold - visible from any vantage point. Since most of the programs are located at the first level, the stairs are a minimum in usage.</p> 
<p>Visual appealing and conducive circulation throughout the building by designing a clear and unobstructed path and proper lighting and ventilation</p>	<p>Dim lighting to enhance a specific ambience. Pathways are narrow and mechanically ventilated.</p> 	<p>Dim lighting to enhance a specific ambience. Pathways are wider and mechanically ventilated.</p> 
<p>Provision of transition of space or shared space that promotes social interaction</p>	<p>Transition area is provided for every attraction / program.</p> 	<p>Transition area becoming part of the pathway.</p> 
<p><b>BUILDING ELEMENTS</b> Provision of plazas, indoor and outdoor spaces and seated landscape</p>	<p>Only provide public plaza at the entrance - Other facilities are shared with the attached shopping mall. Public plaza is filled up with attention grabber programs.</p>	<p>Only provide public plaza at the entrance - Other facilities shared with the attached shopping mall — the open area equipped with attention grabber programs.</p>
<p>Provision of interactive and other forms of visual appealing elements along corridors, pathways and common areas</p>	<p>Inserted with attractive mural, and decorative elements that promotes specific theming attractions.</p> 	<p>Inserted with industrial elements of steel, promoting masculine feelings that are associated with battling atmosphere.</p> 
<p>Provision of drinking fountain and benches or other forms of seating area at transition space and corridor and pathway</p>	<p>Provided at the reception area &amp; kids zone.</p> 	<p>Provided at the reception area.</p> 

(Source: Author)

Table 2: Active design strategies in eSport Arena

ACTIVE PARAMETER		eSPORT ARENA
BUILDING PROGRAM	What is the main function and activities of the building?	Exergaming centre cum educational and research centre for different target group including amateur gamers, professional players and researcher.
	How are the spaces planned or programmed?	<p>Spaces split into two levels: ground level for the public and upper level for the specific targeted groups. The building separated in two wings with a central specialised courtyard that spanned into a public zone.</p> <ul style="list-style-type: none"> <li>- Education: Mainly for the public. Act as introduction device for the public to understand what exergaming is.</li> <li>- Exergaming: Semi-public spaces where the hybrid between exercise and digital entertainment form a new way of burning excessive calories.</li> <li>- Research and development: Private spaces where thousands of graphics card installed in generating cryptocurrency.</li> </ul>
BUILDING STATEMENT	Provide aesthetically pleasing building exterior.	Enhancing inside out architectural style through exposing structure and industrialised theme.
	Proper and convenient drop-off and entrance to building for vehicles and pedestrians	Wide overhang drop-off and entrance.
	Provide transparency of building from main streets and open spaces	High transparency level to promotes indoor-outdoor connections. Inner activities are visible to the outdoor public.
BUILDING SPACES	Allocation of specialised spaces that can create an avenue for physical activities such as exercise rooms or physical games room	<p>The main attraction allows for potential physical activities. The Adventure Games (1) apply human senses and a high degree of a physical obstacle to the surrounding environment. The Racing area (2) challenge vertical physical strength to achieve the targeted goal.</p> 
	To create a movement from one space to another that requires regular physical activities which involve hybrid walking and stair climbing	<p>The pathway challenge the users to be involved with physical activities. Paradox installation encourages the used of staircases. Racing area required the users to used their climbing skill and the Maze instil dynamic movement within the designated obstacle.</p> 

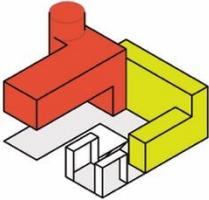
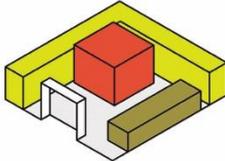
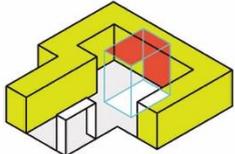
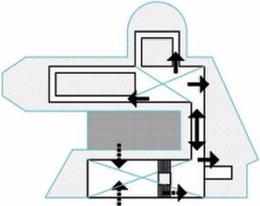
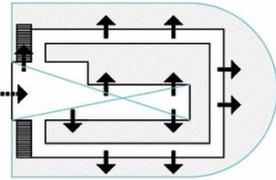
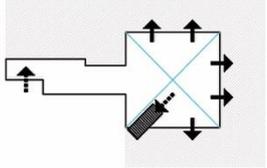
ACTIVE PARAMETER	eSPORT ARENA	
<p>For buildings more than 1-storey high, promote the use of staircase instead of elevators. This can be achieved through staircase visibility, proper staircase design, staircase design appeal, proper signage and the hidden elevator</p>	<p>The staircase is highly visible. Elevators are hidden for the used of disabling user and services.</p>	
<p>Visual appealing and conducive circulation throughout the building by designing a clear and unobstructed path and proper lighting and ventilation</p>	<p>All pathway is widely open without any obstacle. The width range up to 3 meters wide.</p>	
<p>Provision of transition of space or shared space that promotes social interaction</p>	<p>Transitional spaces integrated with the building design, particularly at the main lobby area, paradox installation area, games transitional zone and refreshment zone.</p>	
<p><b>BUILDING ELEMENTS</b> Provision of plazas, indoor and outdoor spaces and seated landscape</p>	<p>Entrance plaza is connected to the maze and the refreshment area. These amalgamated spaces create a free zone that allows for landscape and seating area.</p>	
<p>Provision of drinking fountain and benches or other forms of seating area at transition space and corridor and pathway</p>	<p>Clearly visible at the Maze garden.</p>	
<p>Provision of interactive and other forms of visual appealing elements along corridors, pathways and common areas</p>	<p>Interactive elements are applied at every transitional space, particularly at the Games Entrance Zone where the user is enchanted with a time zone interactive features. There are also arcade games along the main circulation area that promotes initial human engagement to the gamers technology before entering the real exergaming zone.</p>	

(Source: Author)

### 5.0 Discussion

Based on the Active Design Relationship Model and Framework, the building program is the central guiding principle of active design that prescribe the attributes of building statement, internal spaces and building elements.

Table 3: Approaches to Active Design Strategies for Technology-Driven Activities

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	<p><u>Organisation:</u> Organisation of major program shall translate the active design features of the building.</p>						
		The major program is positioned at the end of the block. Active design features are translated as the <b>thematic narrations</b> 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 <b>curiosity experience</b> .	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 <b>atmospheric theme</b> .			
BUILDING SPACES	<p><u>Circulation:</u> Circulation of active design shall be translated through different movement that generates overall building organisation.</p>						
		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	<p><u>Enhancement of activities through Building Elements:</u></p> <p>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.</p> <p>Hatches at three-sided blue cube indicates the level of engagement with its user.</p>	POD - Sedentary state		POD - Sedentary state		POD - Sedentary state	
		POD 2 - High engagement		POD 2 - Low engagement			
		RACING - High engagement		HURRICANE - Low engagement			
		MAZE - High engagement		HOLLOWALL - Medium engagement			
		ADVENTURE - High engagement		ZERO LATENCY - High engagement		ARENA - Low / Medium engagement	

(Source: Author)

These four (4) guiding principles represent environmental factors that resonate personal determinants and creating physical activities. The three (3) case studies of exergaming centres denote one type of technological-driven building that translated the application of active design strategies into three (3) approaches as documented in Table 3. In this analysis, it is evident that interdependency state, internal organisation, circulation and activities are the factors that measure the success of active design strategies for an exergaming centre.

For a technological-driven building, interdependency state shall determine the overall building statement. Being independent will provide more opportunity in delivering physical activity and maximising the human senses. The eSport Arena allowed for a powerful statement as compared to The Rift and Battle Arena. For an attached facility, the visible and bold entrance shall indicate its active level as applied by The Rift.

The organisation of the major program determines the active design features of the building. Positioning the major program as the final climax allows the arrangement of spaces according to a particular narration. Potential active venues are becoming more connected, hence multiplying transitional space. According to Table 3, this strategy is applied in eSport Arena. In the context of the centralised position, the major programs can be enclosed or visible depending on the client's intention. As technological-driven facilities, enclosed major program, as shown in The Rift is more dynamic as it enhances curiosity experience. In the case of open major programs demonstrated by Battle Arena, active features become more limited to the atmospheric experience of spaces.

Movement of circulation generates active design, especially for sedentary exergaming facilities. It is found that radial in corresponding to the centralised movement creates dynamic effects of an active strategy. Centralised movement indicates collective nodes such as plaza, courtyard, stage, transitional hall or any congregation area. Radial movement allows users to move in and out based on the centralised zone, hence complementing it. Out of the three case studies, the eSport Arena provides the best combination of movements while Battle Arena needs more upgrading in terms of its circulation.

Movement, specifically related to physical activity with the control of self-determinants, is being enhanced through the dynamic collaboration of program activities and building elements. In Table 3, Battle Arena provides the least engagement of all the parameters. However, there are a few improvements of program activities between The Rift and eSport Arena particularly at Pod 2, Hurricane to Racing, Holowall to Maze and Zero Latency project into the Adventure Games. The improvements highlighted a direct and active engagement between the environments, user senses and the self-determination outcome.

As design and technology face rapid changes through time, the implication of the three (3) approaches are becoming more strategic due to their flexible nature. In this situation, the approaches set up a new parameter for the future of a technological-driven building. By manipulating the building programs, one can dissect the monotype of exergaming centre into multiple typologies of a technological-driven building that can potentially integrate with any other existing building types.

## 6.0 Conclusion

Technology-driven activities are slowly making their pace in Malaysia. However, the activities only focus on technology advancement that helps to simulate physical activity without much consideration towards the physical engagement with its surroundings. In order to ensure a long term efficacy of active lifestyle among the youth, this requires the integration of technology-driven activities with active design.

The active design can only be enhanced through the understanding of the active design relationship model. The model emphasizes on the three (3) pillars of interrelationship that connects the physical environment, personal determinant and physical activity. The model also becomes the basis for the active design framework. The eSport Arena is an example of the implementation of the active design framework into the technology-driven activities. Apart from creating a holistic program and environment for enhancing physical activities, the eSport Arena provides a platform for further research and exploration of how active lifestyle can be achieved through the integration of technology into the built environment.

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