Adopting Favorable Health Behavior Through Virtual Reality Games: *A Theory And Evidence-Based Review*

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Introduction: The rise of VR games in Health Promotion

Virtual reality (VR) has been around for decades. In its development, VRs are technological solution that allows users to experience a deep immersion into a digital environment (Carvalho et al., 2016). Games delivered using VR offers highly immersive virtual setting where users can control their experience, supported through devices such as earphones and consoles (Carvalho et al., 2016). While VR games are designed primarily for entertainment, they are also integrated as solutions to address important issues.

Healthcare delivery has shown significant changes over the years to better achieve equity. The use of digital technology is now combined in healthcare to accommodate diverse needs, such as those who are victims of the digital divide, areas that are geographically isolated and are short in healthcare facilities and workers. This reform has opened vast opportunities where technology can eliminate geographical gaps, address inadequate number of facilities and healthcare workers and improve intervention quality in general. VR have their unique advantages. As they were originally developed to offer optimum gaming experience for users, VR based mediums often have a high entertainment value. They have a strong interactivity and immersive nature that improves experience so that people are more likely to stay engaged, use them frequently and over long hours (Carvalho et al., 2016). This high engagement among audience is how messages and information is best transferred. These features are what make VR games a viable media to support the delivery of healthcare.

The application of new media such as VR games is particularly useful in management of chronic illness, disease prevention and building healthy habits. They may not replace diagnostic procedures nor doctor-patient communications. As an example of new media application in practice, they offer important complementing role to enhance traditional services.

The involvement of VR games in healthcare is predominantly discussed to encourage behavior adoption. Within the realm of health education – a field that combines the principles of marketing, communications and health sciences to drive change -- VR games have recently gained recognition (Petrigna and Musumeci, 2022). This surge of evidence is particularly apparent during and post Covid-19, where VR games are introduced and marketed to address sedentary lifestyle (Gao et al., 2020). Other body of evidence scattered in different health fields showing how VR games are combined to improve health management (Petrigna and Musumeci, 2022; Saab et al., 2022; Fang and Huang, 2021; Yen and Chiu, 2021), such as obesity and non-communicable disease (Gao et al., 2020), chronic illnesses (Miller et al., 2016), management in elderly health (Fang and Huang, 2021; Siricharoen, 2021) and depression (Yen and Chiu, 2021). It is also mentioned to serve as an education alternative to build healthy habits across children and adolescents (Biddis and Iriwin, 2010; Fowler et al., 2024).

Examples of VR games may include widely commercialized VR games such as *Wii*, *Sony EyeToy*, *Dance Dance Revolution* and *Xbox Kinect* which is not intended for health, but pose the benefits anyway due to the games that require movements from users. There are other specifically built VR games to encourage sedentary lifestyle and obesity prevention that are often piloted in various contexts (Tao, 2021). These games, similarly designed to any entertainment-based VR games, containing features that help instruct users to play in a storyline along with characters and contain features such as rewards (points and badges) (Tao et al., 2021).

Our study aims to continue the work of existing literature to explain how virtual reality games can achieve what it is intended to do in the field of health promotion, which is to support behavior change. While current literature has partially performed this objective, our study will focus specifically on the mechanism of change that is stimulated by virtual reality games. We will investigate the motivation, intrinsic traits, factors from the environment that explain the needs of people who require change and more importantly, how virtual games can be a strategy in doing so.

Theory Application: Explaining motivation and behavior using the *Health Belief Model*

To provide a more structured analysis, we used behavioral models to understand how and why VR games can serve as a supporting tool in health management and prevention. We also explain how VR games can strategically meet the needs of patients or health-enthusiasts. Behavior models are frameworks to help explain people's motivation to adopt a behavior, improve knowledge and shift beliefs. They originate from different disciplines such as psychology, communications and behavior economy which are highly applied today across the field of health promotion. One of these models is the *Health Belief Model*, a study of motivation

and their effects on behavior change mechanisms (Lee and Kottler, 2011). The model is underpinned by five constructs which includes *perceived susceptibility*, that explains people's view of the risks of getting the disease or health issue, *perceived severity* of consequences if a person is to catch the disease, *perceived benefits* if their behavior were to change, *cues to action* which are potential external motivators or stimulants that can drive change and *self-efficacy* which is people's confidence in performing the action.

Since VR games are popularly used to encourage physical exercise, we will use it as a demonstration in this study. To determine whether and how far VR games can help manage health, we require a map of users' current attitude and knowledge about the issue. Users will require the knowledge about their future risks (*perceived susceptibility*) if they continue living in a sedentary lifestyle and how much resources and efforts are required to address the issue if it were to happen (*perceived severity*). They would also have the right knowledge about the benefits of exercising (*perceived benefits*). The higher their perceived susceptibility, severity and benefits, the more likely users will benefit from the VR games.

Cues to action refers to how users act if there are external motivators which may include the environment, norms, people's support or artificially created through interventions. VR games can be an example of an intervention that may encourage people to start or stay committed. VRs have a high entertainment value, highly interactive and hence, may serve as an effective attraction for users to learn and implement an active lifestyle. As VR games often have story plots, they can be designed to include reminders, important information to build people's motivation and capacity in managing difficult settings (ie, falling back into old habits).

Finally, *self-efficacy* is a highly significant determinant to a successful behavior adoption. Users require some confidence and trust towards their own abilities in performing their behavior. Self-efficacy is highly linked to the availability of cues to action. Improving users' opportunity to be exposed to the right "cue" within a strategic time will increase people's perceived ability to perform the behavior. When there is the right intervention to persuade people about the benefits of an exercise, a demonstration that physical exercise can be done through the comfort from home and through fun activities (VR games), users are more likely to be confident in conducting their behavior.

These analyses inform whether people may need or are motivated to access VR games to manage their health. When awareness is high (all three perceived susceptibility, severity and benefits), people may behave in a couple of ways. One way is that people are already motivated and merely require a supporting tool such as a VR game to maintain their commitment. Another outcome is that since they are already aware and are motivated, they may not need to use anymore supporting tools. To further understand this phenomenon, we resort to literature (Tao et al., 2021; Gao et al., 2016) showing that VR games is highly entertaining and are

convenient for people to seek them for entertainment values while conscious about the health benefits they will receive.

Users who are seeking health benefits also crave entertainment and convenience. In fact, it is more likely that they remain consistent and prevent relapses when the behavior is simple, easy and are low in cost in terms of financial, efforts and time. People are also further more likely to be consistent when the activity has entertainment value (Tao et al., 2021). When the supporting tool contains all these important and attractive features for users, their *self-efficacy* can increase. It may also improve their response strategies when facing the challenging situations where they need to decide to do the right thing (*cues to action)*.

Lessons Learned: Identifying opportunities and challenges in promoting VR games to address health challenges

Adopting new behavior often requires a significant cost that does not have to be financial, but also psychological. Leaving old habits require people to leave comfort and familiarity and sacrifice pleasure, leisure time or time spent with family and friends. They also need to invest time in learning and getting used to performing a new routine (ie, engaging in physical activities, conducting regular checkups). There is also patience required and a high commitment. With much work put into developing change, supporting tools such as digital-based media or virtual reality platforms can help them adapt.

The health belief model illustrates the tensions people undergo when they intend to change. There is a process of internalizing perceived benefits, susceptibility and severity, while also recognizing and using the right skills to respond to any external nudges or factors. Having a strong self-efficacy is also a great contributor to successfully adopting new behavior or knowledge. These factors can be trained or enhanced. For example, there are strategies for people to better understand the health issues so they are able to perceive their own risks, and ultimately make more informed decisions. Secondly, building confidence can be improved through educating the right skills (self-efficacy). The media may also act as a potential cue to action. As explained above, cues to action can be artificially built through interventions and education programs.

Ensuring a complete change of behavior requires a multilevel approach, where each method can complement and not replace one another. Relying on traditional media remains highly important, and so patients should continue attending regular medical check-up when required. However, people may not understand when they should see a doctor or if their risks are severe enough to prompt for a doctor visit. Health promotion specialists can offer support by providing information intervention to encourage people to attend doctor visits. Health issues are often multifaceted. In addition to strengthening treatments, health promotion specialists should invest in strengthening prevention. This is highly relevant in obesity

prevention and building healthy lifestyle. VR games can be an alternative within a new media category in educating people, providing people with the right capacity to assess their risks and ultimately achieve intended goals.

Entertainment is a highly underrecognized component in health education (Tao et al., 2021). When adopting behavior is already a difficult process, incorporating play, fun and entertainment can make this easier on users. Informing patients should also be more effective if they are more engaged. Having a conducive environment to perform their behavior is also key. According to Tao et al (2021), these VR games can be designed to set up a virtual environment where users can perform the behavior. They can also design an educational component using information wrapped in an entertaining storyline as users. Another highly attractive feature of VR games is that they can be played in solitude. This may be helpful for individuals who experience discrimination or judgments resulting from stigma. Examples could be people who are extremely overweight and are looking to lose weight by increasing their physical activities.

However, like most media, they also have their challenges. Games that are built using VR often has a high learning curve, particularly for new users (Logeswaran et al., 2021). They are also power heavy, meaning they require a strong internet access and absorbs much of the power device. Their sophisticated technology also make them only compatible in specific devices that meet certain quality. Examples would be smart TVs, phones and the more recently developed PCs. This means there is a potential for a digital divide.

Digital equity remains a significant challenge in expanding new media and other technological solutions. This means that those who can reap the benefits of using VR games to enhance their health decision-making are those who are able to stay connected to the services. Internet connectivity while has expanded nationwide, there remains areas with poorer access, such as people living in rural and remote locations (APJII, 2022).

Online facilitated games can potentially cause addiction or prolonged use. This is also a possibility for VR games. While VR games that are designed with a clinical objective are less likely to cause such, other commercial games with activities that require physical movements. An active VR game player often plays more than a single game. Promoting these VR games to champion for an active lifestyle may unconsciously encourage increased use among users. They may extend to increase more time to play other games that have nothing to do with improving their health habits. This creates a conducive setting for users to increase their screen time, and therefore, cause an adverse effect that is opposite to the health goals.

Recommendations: contextualizing VR games in Indonesia

A potential health challenge where AR games can be beneficial to solve is obesity in Indonesia. A sedentary lifestyle is one of the biggest factors behind obesity and

non-communicable diseases. In Indonesia, rates of adolescence obesity continues to rise (Ayuningtyas et al., 2022) and addressing risk factors continues to become a national agenda. Considering the important and unique advantages of VR games, VR games can enhance existing health services and help promote active lifestyle. However, their prevalence to tackle health challenges is a fairly new concept (Tao et al., 2021). Compared to other more popular new media such as digital health applications or social media, they receive less loyal users. They have also mostly been reported to be popular across the higher income nations (Tao et al., 2021). This indicates that more studies need to be conducted to understand its potential.

If VR games are found to offer more benefits than costs, the next steps of introducing and scaling their use in Indonesia would require a lot of testing. To apply this concept in Indonesia, there needs to be a greater assessment as to whether and how VR games can enhance current systems. A highly important aspect to consider is learning about the success components behind a VR game that is based on evidence across other contexts. Bringing these success factors into Indonesia would require an adaptation process that may mean conducting pilot and feasibility tests.

Other important considerations also include ensuring that challenges that come from using AR games can be managed. Potential issues such as addiction, adverse effects that lead to sedentary lifestyle need to be addressed to reap optimum benefits of AR games. Therefore technological solutions need to be best developed using these considerations in mind.

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