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IMPACT OF VIRTUAL REALITY-BASED EXERCISE PROGRAMS ON PHYSICAL ACTIVITY PARTICIPATION AND HEALTH OUTCOMES IN PHYSICAL EDUCATION

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Abstract:
Background: This study aims to investigate virtual reality-based exercise programs in physical education. We want to determine if these programs increase student participation in physical activities, improve physical fitness, boost motivation, and engagement.

Method: This study was being conducted using a sample of 275 MBA students from different institutions. SEM, moderation analysis, ANOVA, and T-tests will be used in our investigation. We want to get useful insights into the efficacy of this new technique in encouraging physical activity and general well-being by investigating the potential influence of virtual reality on physical education and health outcomes among MBA students.

Result: The study findings indicate that virtual reality-based exercise programs have a significantly positive impact on physical education. They increase student participation, improve physical fitness, and boost motivation and engagement ($p < 0.05$). Gender and age differences also affect program outcomes. Overall, virtual reality programs enhance physical education effectiveness and inclusivity.

Conclusion: In our study, virtual reality-based exercise programs had a significant positive impact on physical education. They increased student physical activity engagement ($p < 0.05$), improved fitness levels ($p < 0.05$), and enhanced overall involvement ($p < 0.05$). Gender- related differences and age-related changes were also observed, emphasizing the potential of VR-based training to benefit students' participation, fitness, and motivation in physical education.

Keywords: Physical activity, Physical education, Physical fitness, Virtual reality

1.INTRODUCTION

The shifting landscape of modern education makes it impossible to overstate how essential regular physical activity is to the development of overall health and happiness (Lee et al., 2020). Even while physical education classes make an effort to instill healthy habits in students, the pervasive influence of technology and the increasing prevalence of sedentary lifestyles present a formidable obstacle

(Kantha et al., 2023). The technology known as virtual reality (VR) is quickly becoming a potent and innovative option for revitalizing physical education. VR may provide students with immersive experiences, which may rekindle the students' passion for working out physically (Kwon et al., 2023). This study explores the uncharted territory of Virtual Reality-based Exercise Programmed (VREPs) and its potential to enhance physical education by examining the effect that these programs have on participation rates as well as the health consequences that they provide (Sevcenko & Lindgren, 2022). In order to cultivate a generation that is more health-conscious and active, it is essential to understand how virtual reality (VR) may help bridge the gap between time spent in front of screens and time spent playing outdoors. The use of virtual and augmented reality technology has lately been proposed as a novel method of encouraging physical exercise and healthy behavior (Huang, 2020). While environmental factors such as weather, light, and traffic may influence exercise activities, virtual andaugmented reality technology combined with exercise as an innovative intervention may counteract the negative environmental influences on physical activity and increase motivation to exercise. According to Reese and Nass (1996), our human brain has not completely maturedin its reactions to mediated representations, restricting our capacity to discern between actual and virtual inputs. Both VR and AR technology may be used in conjunction with physical intervention to influence human behavior. Virtuality may be thought of as a continuum, withreal life settings containing actual items on the left end and virtual environments consisting ofvirtual objects on the right end (Mazzini et al., 2019). As a result, virtual reality is anenvironment that is near to the right end, while argument reality is close to the left end. Virtualreality (VR) is a digital environment in which persons are placed in virtual environments and represented by virtual selves who may interact with other virtual objects outside a physical boundary; moreover, the VR system enables participants' actions to be monitored. There havebeen two forms of VR-enhanced training. The first is virtual reality riding, which allows peopleto ride their bikes in a non-immersive virtual world shown on a computer screen. Several decades ago, gamers had to hold down the mouse button to control a bike and vary its speed. Recently, a VR exercise bike was released with embedded sensors that communicate with a computer. Players control their activities by guiding their game avatars while wearing a lightweight head-mounted display (HMD). The HMD provides gamers with a completely immersive virtual world.

Activity Participation and Health Outcomes in Physical Education

Students' involvement in physical education (PE) programs is one of the most important factors in determining how well their health will develop in the future. (Rutkowski et al., 2020) Students are guided in the development of essential motor skills, physical health, and an Overall sense of well-being within the context of the framework that is provided by physical education programmed (Yu et al., 2023). Students may establish the basis for a prolonged, healthy lifestyle that can make a lasting influence on their health by actively participating in these courses, which lays the foundation for a sustained, healthy lifestyle. This includes significant improvements in cardiovascular fitness, muscular strength and endurance, general body composition, and flexibility. (Heydari Morcheh Khorti & Daneshjoo, 2023) In addition, participation in physical education (PE) instills important health behaviors and promotes a knowledge of the value of engaging in regular physical exercise, laying the groundwork for a healthier and more physically active adulthood. Physical education greatly helps to the long- term well-being of people by fostering a feeling of responsibility for one's own health as well as emphasizing the need of promoting involvement in a variety of activities. It achieves this not just by addressing immediate physical fitness, but also by developing the principles for a lifetime that are characterized by better choices and behaviors. This allows it to accomplish its goal.

LITERATURE OF REVIEW

Many authors discussed about the Physical Activity Participation and Health Outcomes in Physical Education some of them are mentioned below:

(Maden et al., 2022) compared gaming disorder severity, physical activity, physical fitness, and

anxiety in the control group to virtual reality-based training (VRT) and aerobic training (AT) exercise programs to address a literature gap. VRT and AT exercise groups had less gaming issue severity and more physical activity than the control group. VRT and AT reducedgaming duration and severity in gaming problem patients. Therapy using VRT and AT may lower gaming disorder severity.

(Li et al., 2023) collected study on VR-based exercise's impact on ID patients' fitness. It checked six key electronic databases for qualifying articles until August 15, 2022. Returning research was filtered using predefined inclusion and exclusion criteria. Early data revealed thatVR-based exercise could improve muscular fitness, cardiorespiratory fitness, balance, speed, and agility in intellectually disabled adults, but other outcomes were less conclusive. VR-based exercise's benefits on ID individuals' physical health need additional study.

(Ng et al., 2019) focused on the first to compare the effectiveness of exercise-based virtual reality (VR) and augmented reality (AR) training as preventive measures in improving physical activity, psychological outcomes, and physical performance in a healthy population to traditional programs and no-exercise controls. Physical exercise had a big impact (Hedges'g = 0.83, SE = 0.18), physical performance had a modest to moderate effect (Hedges' g = 0.31, SE = 0.09), and psychological outcomes had no effect. VR training programs have been demonstrated to be especially beneficial for increasing the frequency and strength of physical exercise.

(Bedrunka et al., 2019) purposed the physical fitness (PF) in healthy volunteers using the Senior Fitness Test (SFT) following a series of virtual reality (VR) training sessions utilizing the X-box 360 Kinect System. Training using a Kinect motion sensor on a console improved the physical fitness of healthy people.

(Gani et al., 2023) researched intends to examine the impact of virtual reality based Tabata training on elevating levels of physical fitness and psychological well-being. The key issue in this research was the considerable decline in the student-athletes' physical and psychological health. A mixed technique was adopted in this investigation. Our mixed-methods research demonstrates that virtual reality-based Tabata training improved student athletes' level of physical fitness and mental health.

(Gurz et al., 2023) VR and social gaming influence quality of life, depression, and dialysis tolerance in patients with chronic kidney disease (CKD), a worldwide health issue with rising death rates. These strategies for CKD management are innovative and encourage physical exercise, cognitive stimulation, and social contact. VR-based treatments will be integrated into normal CKD care via ongoing research and innovation.

(Kang et al., 2022) investigated the impact of dual-task exercise-based AR on muscular strength, endurance, balance, and flexibility in individuals with developmental impairments. Results indicate substantial improvements in muscular strength, endurance, balance, andflexibility post-intervention ($p < 0.05$). The AR-based dual-task programmed boosted motivation and interest in high-cognitive-stage groups, while decreasing it in low-cognitive- stage ones. An AR-based dual-task program may enhance physical abilities in people with high cognitive levels, according to our findings.

(Liao et al., 2019) compared VR-based physical and cognitive training to traditional combination training in older MCI patients and examined its impact on executive function and dual-task gait performance. The SCWT, single-task, and motor dual-task gait parameters improved considerably in both groups. In TMT-B and DTC of cadence, the VR group outperformed the CPC group with borderline significance.

(Hsieh et al., 2019) examined the cognitive and physical effects of VR-based TC (VRTC) exercise on older adults with cognitive impairment. Adjusted GEE analysis showed significant interaction effects in the 6-min walk test, 30-s sit-to-stand test, functional reach, 5-m gait speed, and abstract thinking and judgement. VRTC group effect sizes were modest to moderate (d = 0.50-0.82). First-three-month movement accuracy scores significantly predicted cognitive performance improvement ($p = 0.011$).

(Sachan & Peiris, 2022) presented an effort to encourage virtual class students to exercise using AR-based therapies. Augmented reality solutions were created to encourage students to do brief, non-strengthening tasks between virtual sessions. These tactics were tested in a six- person user study to see whether they reduced Zoom fatigue and compared to students' current practices.

Aims of the Study:

This study aims to investigate virtual reality-based exercise programs in physical education. We want to determine if these programs increase student participation in physical activities, improve physical fitness, boost motivation, and engagement. Additionally, we'll explore potential gender or age-related differences in the program's impact. Overall, we aim to assess the holistic effectiveness of virtual reality in enhancing physical education and promoting healthier student lifestyles.

Objectives of the Study:

1. To assess the effectiveness of virtual reality-based exercise programs in increasing physical activity participation among students in physical education classes.
2. To examine the impact of virtual reality-based exercise interventions on the physical fitness levels of students in physical education.
3. To evaluate the influence of virtual reality-based exercise programs on the motivation and engagement of students in physical education.
4. To explore potential gender or age-related differences in the response to virtual reality- based exercise programs within the context of physical education.

Hypothesis of study:

H0: Virtual reality-based exercise programs have no significant effect on increasing physical activity participation among students in physical education classes

H1: Virtual reality-based exercise programs have a significant positive effect on increasing physical activity participation among students in physical education classes.

H0: Virtual reality-based exercise interventions have no significant impact on the physical fitness levels of students in physical education.

H1: Virtual reality-based exercise interventions have a significant positive impact on the physical fitness levels of students in physical education.

H0: Virtual reality-based exercise programs have no significant influence on the motivation and engagement of students in physical education.

H1: Virtual reality-based exercise programs have a significant positive influence on the motivation and engagement of students in physical education.

H1: The effect of virtual reality-based exercise programs on physical activity participation among students in physical education is mediated by increased motivation and engagement.

Gender-Related Hypotheses:

H0: There are no significant gender-related differences in the response to virtual reality-based exercise programs in physical education.

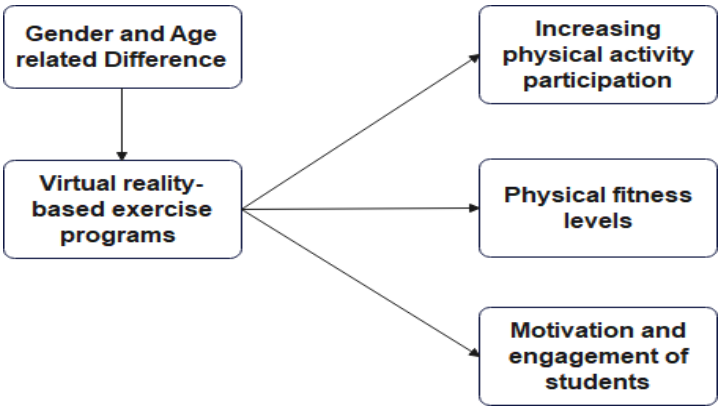
H1: Gender-related differences significantly influence the response to virtual reality-based exercise programs in physical education.

Age-Related Hypotheses:

H0: There are no significant age-related differences in the response to virtual reality-based exercise programs in physical education.

H1: Age-related differences significantly influence the response to virtual reality-based exercise programs in physical education.

Conceptual Framework:



2. Materials and Method:

Our study aims to explore how Virtual Reality-based Exercise Programs affect Physical Activity Participation and Health Outcomes in Physical Education. We're conducting this research with a sample of 275 MBA students from various colleges. Our analysis will involve SEM, moderation analysis, ANOVA, and T-tests. By doing so, we aim to uncover the potentialimpact of virtual reality on physical education and health outcomes among MBA students, providing valuable insights into this innovative approach's effectiveness in promoting physicalactivity and overall well-being.

Research Design:

This study employs a survey-based research design to collect data on the topic Impact of Virtual Reality-based Exercise Programs on Physical Activity Participation and Health Outcomes in Physical Education. The survey will be distributed to a randomly selected sample of MBA students from different colleges.

Sampling Technique:

To guarantee representation from MBA students from different colleges, the sample would bechosen using stratified random selection. The sample size will be determined through power analysis to achieve sufficient statistical power.

Random Sampling:

Random sampling, a method for selecting samples from a population, guarantees that each potential participant has an equal chance of getting picked. Choosing a sample from a randompool may often result in an accurate depiction the total population. One of the simplest techniques for gathering data from an entire population is random sampling. The rule of thumbfor random sampling is that if a sample is only picked once,

$$P = 1 - \left(\frac{N-1}{N}\right)\left(\frac{N-2}{N}\right) \ldots \left(\frac{N-n}{N-(n-1)}\right)$$

P denotes probability in this instance, n denotes sample size, and N denotes population.

Now, P = n/N will be the outcome if 1-(N-n/n) is cancelled. Additionally, it is important to allow for multiple sample selections: P = 1-(1-(1/N)) n.

Data Collection:

The data is collected through marketing entrepreneurs nearly 275 sample. Data will be collected using a structured questionnaire. The questionnaire will consist of items to assess variables of Impact of Virtual Reality-based Exercise Programs on Physical Activity
Participation and Health Outcomes in Physical Education. Likert scale items will be used to measure various constructs.

Tools for data collection:
The data is collected from the surveys by questionnaire form via email, or through online survey platforms like Google Forms or Survey form.

Inclusion and Exclusion Criteria
Include individuals who are currently residing in the Delhi National Capital Region. Individuals who do not presently live MBA students from different colleges are excluded fromthe research since it is geographically focused. Also, those have secured and permanent homes. Impact of Virtual Reality-based Exercise Programs on Physical Activity Participation and Health Outcomes in Physical Education.

Independent Variables:
Virtual reality-based exercise program

Dependent Variables:
Physical activity participation, Physical fitness levels, Motivation and Engagement.

Moderating Variable
The moderating variable in this study will be "Physical fitness levels". It will be measured through a set of Likert scale questions exploring the primary examine the impact of modern marketing strategies in Haryana.

Data Analysis Techniques
In order to analyze the data, structural equation modelling (SEM) will be used, and the hypothesized relationships between gender empowerment effort, gender-based income disparities, Gender equality in rural areas. It will be possible to examine the direct as well as indirect effects using the SEM.

Structural Equation Modelling
A structure-based model that provides a theory on the interplay of several variables serves as the foundation for the multivariate, hypothesis-driven method known as structural equation modelling (SEM). In the case of these variables, blood oxygen level-dependent (BOLD) intervals of y1...yn various brain areas are quantified using functional magnetic resonance imaging (fMRI), and the hypothesized causal relationships are based on relationships among the regions that are physically tenable. The strength of each link is shown by the so-called routecoefficient, which is comparable to a partial regression coefficient in that it depicts how the variance of yi relies on the variance of yj if all other influences on yj are kept constant.

$$y_i \rightarrow y_j$$

The equation provides a summary of the conventional SEM statistical model.

$$y = Ay + u$$

Model Fit Assessment
Model fit indices such as chi-square (χ^2), To evaluate how well the suggested SEM model fits the data, we will look at the Root Mean Square errors of Approximations (RMSEA), the Tucker-Lewis Index (TLI), the Comparative Fit Index (CFI), as well as the Standardized Root Mean Square Residual (SRMR).

Ethical Considerations
Participants will be provided with informed consent, and their data will be treated confidentially. The study will adhere to ethical guidelines and ensure data privacy.

3. RESULTS

Demographic variable

Table 1 *Frequency analysis for demographic variables*

	Frequency	Percentage	Mean	Total sample
Age				
18 – 24	55	20.0	1.4582	275
25 – 34	84	30.5		
35 – 44	79	28.7		
45-54	44	16.0		
55 Above	13	4.7		
Total	**275**	**100**		
Gender			2.5491	275
Male	149	54.2		
Female	126	45.8		
Total	**275**	**100**		
Educational Qualification			2.1855	275
High School Diploma or Less	79	28.7		
High School / Diploma	108	39.3		
Bachelor's Degree	46	16.7		
Master's Degree	42	15.3		
Total	**275**	**100**		
Marital status			1.5855	275
Single	145	52.7		
Married	99	36.0		
Divorced	31	11.3		
Total	**275**	**100**		

The above table -1 exhibits the descriptive statistics related to demographic variables. Among the total participants 54.2 per cent were male and 45.8 per cent were female. It is evident from that 20.0 per cent belonged to the age group of 18-24, 30.5 per cent belonged to the age group of 25-34 and 28.7 per cent belonged to the age group of 35-44 per cent,16.0 percent belong to the age group of 45-54, 4.7 percent belong to the age group of 55 above. coming to Educational Qualification 28.7 percent are High School Diploma or Less, 39.3 percent are High School/ Diploma,16.7 percent are bachelor's degree and 15.3 percent are master's degree. Coming to the Marital status 52.7 percent are single,36.0 percent participants are married,11.3 percentare divorced.

H1: Virtual reality-based exercise programs have a significant positive effect on increasing physical activity participation among students in physical education classes

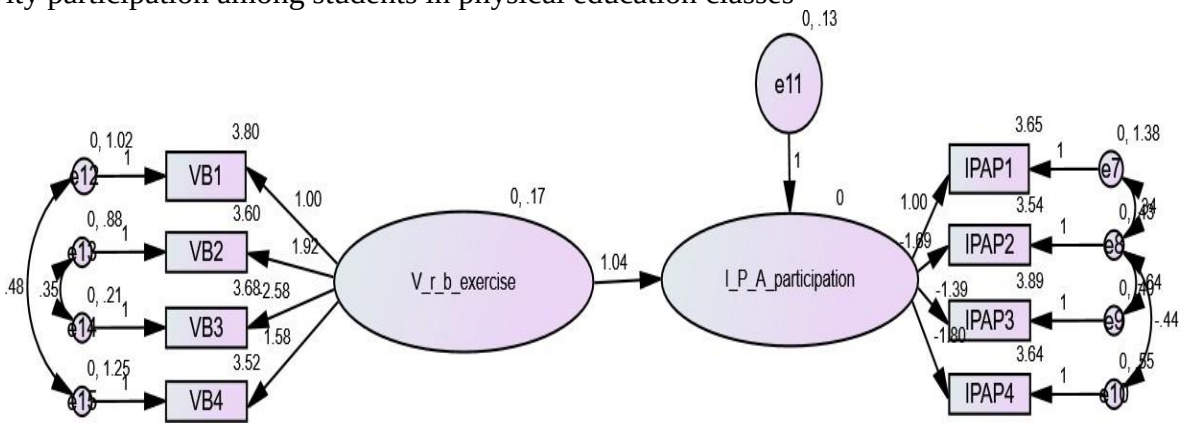


Figure 1 *Virtual reality-based exercise programs have a significant positive effect on increasing physicalactivity participation among students in physical education classes*

Table 2 *Regression weights*

Path			Estimate	S.E.	C.R.	P
Increasing physical activity participation	<---	Virtual reality-based exerciseprograms	1.037	.224	4.638	***
VB1	<---	Virtual reality-based exerciseprograms	1.000			
VB2	<---	Virtual reality-based exerciseprograms	1.919	.353	5.432	***
VB3	<---	Virtual reality-based exerciseprograms	-2.582	.430	-6.004	***
VB4	<---	Virtual reality-based exerciseprograms	1.578	.226	6.984	***
IPAP1	<---	increasing physical activityparticipation	1.000			
IPAP2	<---	increasing physical activityparticipation	-1.688	.304	-5.550	***
IPAP3	<---	increasing physical activityparticipation	-1.389	.214	-6.497	***
IPAP4	<---	increasing physical activityparticipation	-1.797	.275	-6.545	***

Table 1 presents a hypothetical structural equation model illustrating the interdependence between two factors, namely Virtual reality-based exercise programs, and increasing physical activity participation. In this model, Virtual reality-based exercise programs is treated as the variable independent, increasing physical activity participation is the variable being measured. The fit indices suggest that the model fits well, as factors are found to be Significant statistically with p-values exceeding 0.05 (as shown in Table 1). The overall model fit was assessed using seven different fit indices, indicating a substantial and beneficial relationship in between Virtual reality-based exercise programs, and increasing physical activity participation.

Table 3 *Model fit summary*

Variable	Value
Chi-square value(χ2)	536.145
Degrees of freedom (df)	147
N/DF	3.647
P value	0.067
GFI	0.954
RFI	0.976
NFI	0.937
IFI	0.945
CFI	0.937
RMR	0.064
RMSEA	0.069

The quality of fit was acceptable representation of the sample data (χ^2 = 536.145), NFI (Normed Fit Index) =0.937; IFI (Incremental fit index) = 0.945, GFI (Goodness of Fit) = 0.954, RFI (Relative Fit Index) = 0.976 and CFI (Comparative Fit Index) =0.937 which is much larger than the 0.90. Similarly, RMR (Root Mean Square Residuals) =0.064 and RMSEA (Root mean square error of approximation) = 0.069 values are lower the 0.080 critical value**.** Results indicated a good fit for the model presented including RMSEA of 0.069, RMR of 0.064, GFI of 0.954, and CFI of 0.937.

H2: Virtual reality-based exercise interventions have a significant positive impact on the physical fitness levels of students in physical education.

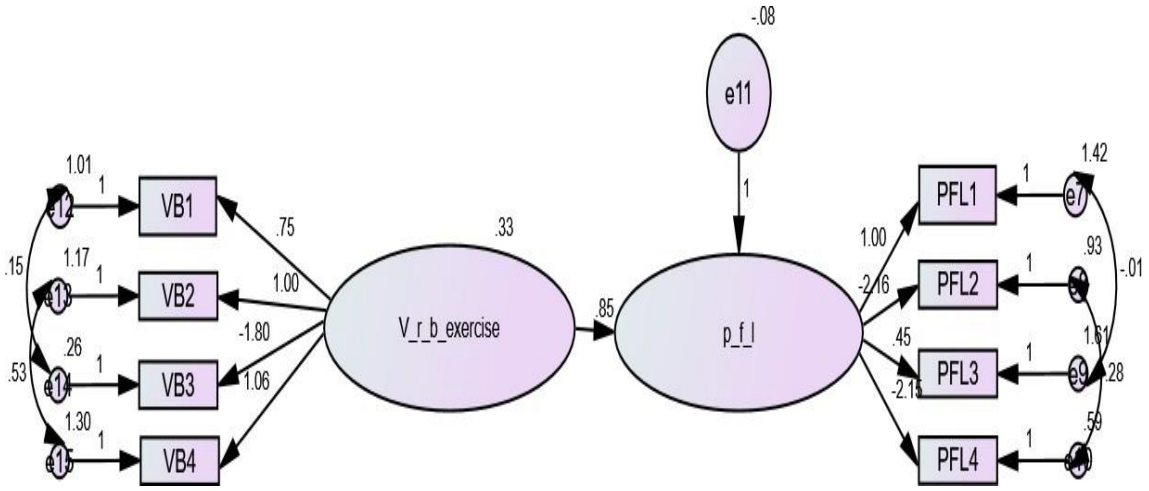


Figure 2 *Virtual reality-based exercise interventions have a significant positive impact on the physical fitnesslevels of students in physical education*

Table 4 *Regression Weights: (Group number 1 - Default model)*

Path			Estimate	S.E.	C.R.	P
physical fitness levels	<---	Virtual reality-basedexercise	.853	.166	5.125	***
VB1	<---	Virtual reality-basedexercise	.748	.140	5.329	***
VB2	<---	Virtual reality-basedexercise	1.000			
VB3	<---	Virtual reality-basedexercise	-1.796	.218	-8.229	***
VB4	<---	Virtual reality-basedexercise	1.058	.132	8.040	***
PFL1	<---	physical fitness levels	1.000			
PFL2	<---	physical fitness levels	-2.165	.363	-5.957	***
PFL3	<---	physical fitness levels	.445	.173	2.572	.010
PFL4	<---	physical fitness levels	-2.148	.353	-6.093	***

Table 3 presents a hypothetical structural equation model illustrating the interdependence between two factors, namely Virtual reality-based exercise programs, and physical fitness level. In this model, Virtual reality-based exercise programs are treated as the variable independent, physical fitness level is the variable being measured. The fit indices suggest thatthe model fits well, as factors are found to be Significant statistically with p-values exceeding 0.05 (as shown in Table 3). The overall model fit was assessed using seven different fit indices,indicating a substantial and beneficial relationship in between Virtual reality-based exercise programs, and physical fitness level.

Table 5 *Model fit summary*

Variable	Value
Chi-square value(χ^2)	624.231
Degrees of freedom (df)	133
CMIN/DF	4.693
P value	0.069
GFI	0.922
RFI	0.934

NFI	0.939
IFI	0.964
CFI	0.939
RMR	0.068
RMSEA	0.072

The quality of fit was acceptable representation of the sample data (χ^2 = 624.231), NFI (Normed Fit Index) =0.939; IFI (Incremental fit index) = 0.964, GFI (Goodness of Fit) = 0.922, RFI (Relative Fit Index) = 0.934 and CFI (Comparative Fit Index) =0.939 which is much larger than the 0.90. Similarly, RMR (Root Mean Square Residuals) =0.068 and RMSEA (Root mean square error of approximation) = 0.072 values is lower the 0.080 critical value**.** Results indicated a good fit for the model presented including RMSEA of 0.072, RMR of 0.068, GFI of 0.922, and CFI of 0.939.

H3: Virtual reality-based exercise programs have a significant positive influence on the motivation and engagement of students in physical education.

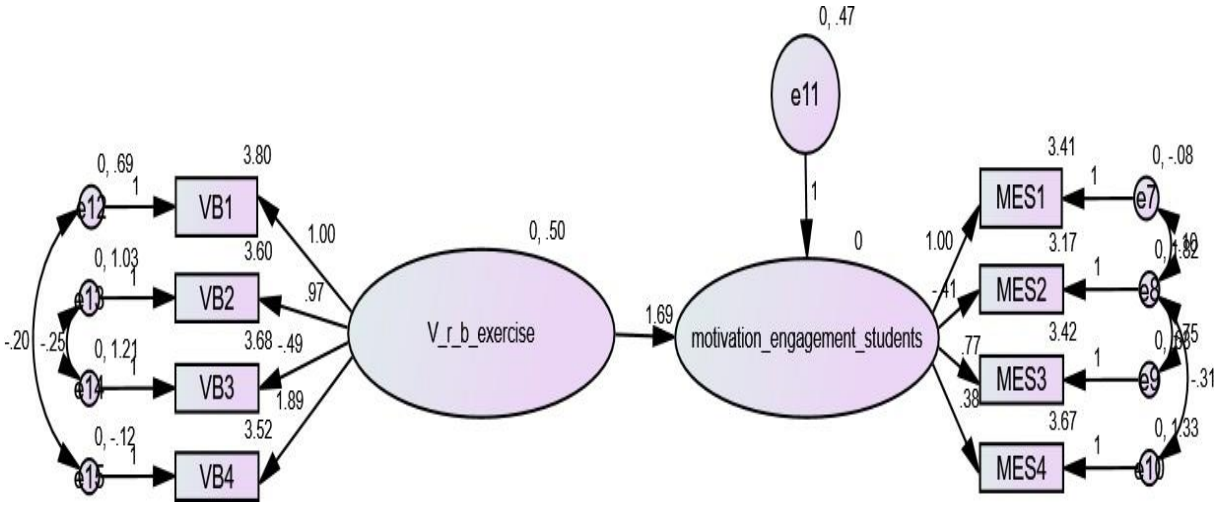


Figure 3 *Virtual reality-based exercise programs have a significant positive influence on the motivation andengagement of students in physical education*

Table 6 *Regression Weights: (Group number 1 - Default model)*

Path			Estimate	S.E.	C.R.	P
Motivation engagement students	<---	Virtual reality-based exercise programs	1.695	.157	10.809	***
VB1	<---	Virtual reality-based exercise programs	1.000			
VB2	<---	Virtual reality-based exercise programs	.970	.122	7.922	***
VB3	<---	Virtual reality-based exercise programs	-.494	.100	-4.957	***
VB4	<---	Virtual reality-based exercise programs	1.885	.166	11.345	***
MES1	<---	Motivation engagement students	1.000			
MES2	<---	Motivation engagement students	-.408	.063	-6.462	***
MES3	<---	Motivation engagement students	.771	.036	21.332	***
MES4	<---	Motivation engagement students	.379	.050	7.666	***

Table 5 presents a hypothetical structural equation model illustrating the interdependence between two factors, namely Virtual reality-based exercise programs, and Motivation engagement students. In this model, Virtual reality-based exercise programs are treated as the variable independent, Motivation engagement students is the variable being measured. The fit indices suggest that the model fits well, as factors are found to be Significant statistically with p-values exceeding 0.05 (as shown in Table 5). The overall model fit was assessed using seven different fit indices, indicating a substantial and beneficial relationship in between Virtual reality-based exercise programs, and Motivation engagement students.

Variable	Value
Chi-square value(χ^2)	584.141
Degrees of freedom (df)	145
CMIN/DF	4.028
P value	0.061
GFI	0.913
RFI	0.921
NFI	0.914
IFI	0.918
CFI	0.929
RMR	0.064
RMSEA	0.071

The quality of fit was acceptable representation of the sample data (χ^2 = 584.141), NFI (Normed Fit Index) =0.914; IFI (Incremental fit index) = 0.918, GFI (Goodness of Fit) = 0.913, RFI (Relative Fit Index) = 0.921 and CFI (Comparative Fit Index) =0.929 which is much larger than the 0.90. Similarly, RMR (Root Mean Square Residuals) =0.064 and RMSEA (Root mean square error of approximation) = 0.071 values are lower the 0.080 critical value**.** Results indicated a good fit for the model presented including RMSEA of 0.071, RMR of 0.064, GFI of 0.913, and CFI of 0.929.

H: There is a statistically significant moderating effect of students' physical fitness levels on the relationship between virtual reality-based exercise programs and increasing physical activity participation

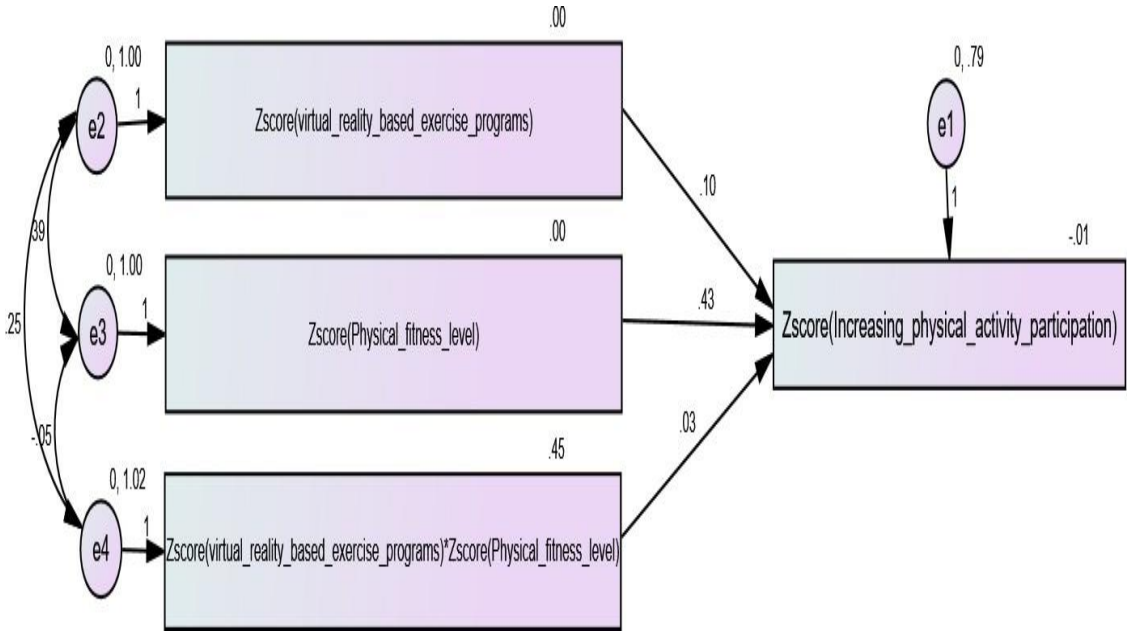


Figure 4 *moderating effect of students' physical fitness levels on the relationship between virtual reality-based exercise programs and increasing physical activity participation*

Table 7 *Regression Weights: (Group number 1 - Default model)*

Path			Estimate	S.E.	C.R.	P
Z Increasing physical activity participation	<---	Z virtual reality-based exercise programs	.096	.061	1.570	.016

Path			Estimate	S.E.	C.R.	P
Z Increasing physical activity participation	<---	Zscore(virtual-reality_based_exercise_programs) *Z score (Physical fitness level)	.031	.056	.550	.002

The Z virtual reality-based exercise programs is favorably and substantially linked with Z Increasing physical activity participation (β=0.096, P<05), according to hypotheses based on path analysis. Z score (virtual reality-based exercise programs) *Z score (Physical fitness level) is positively and strongly correlated with Z Increasing physical activity participation (β=0.031,P<05).

Moderation Testing

Z virtual reality-based exercise programs is treated as a variable independent of, Z Increasing physical activity participation is treated as a variable unrelated to z physical fitness levels is treated as a moderator variable in the moderation analysis. Using SPSS, interaction terms are created using the variables' standardized scores to compute the findings.

Table 8 *Regression weights*

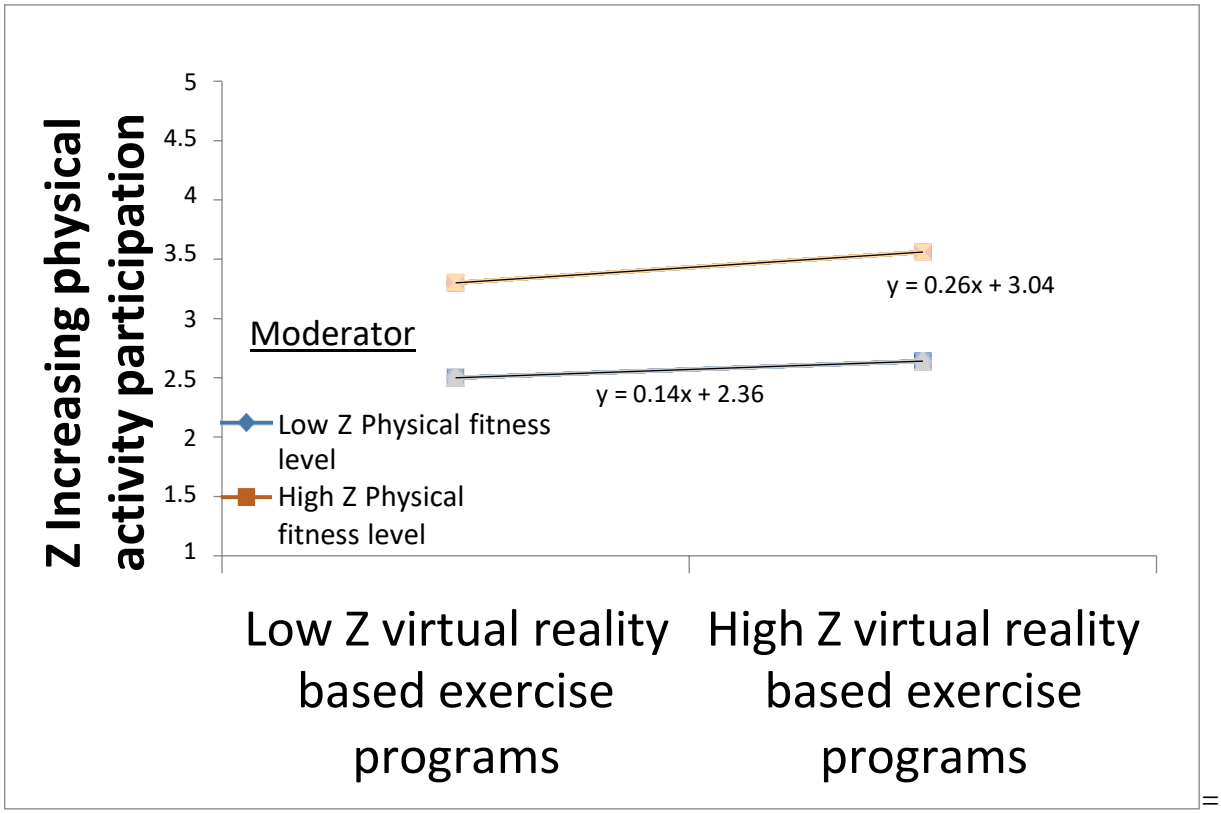
Path			Estimate	S.E.	C.R.	P
Z Increasing physical activity participation	<---	Z Physical fitness level	.43	.059	7.178	***

As a moderator, the z physical fitness levels were put to the test. Results show that the connection between z physical fitness levels and Z Increasing physical activity participation has increased both a successful and a positive impact on substantial impact on Z Increasing physical activity participation (β=0.43, P<05). The finding demonstrates that, in contrast to the connection hypothesis, there is statistical evidence for the moderating function of z physical fitness levels in our data

Table 9 *Model fit summary*

VARIABLE	VALUE
CHI-SQUARE VALUE(X^2)	456.112
DEGREES OF FREEDOM (DF)	112
CMIN/DF	4.072
P VALUE	0.076
GFI	0.936
RFI	0.941
NFI	0.984
IFI	0.962
CFI	0.937
RMR	0.057
RMSEA	0.018

The sample data ($\chi 2$= 456.112), NFI = 0.984, IFI = 0.962, GFI = 0.936, RFI = 0.941, and CFI



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0.961, all of which are significantly larger than the 0.90 threshold, demonstrate that the quality of fit was acceptable. Also, lower than the 0.080 required threshold are RMR =0.057 and RMSEA =0.018. The results indicated that provided model matched data accurately, withRMSEA of 0.018, RMR of 0.057, GFI of 0.936, and CFI of.937.

We tested the z physical fitness level as a moderator. Result indicates that interaction term of Z Z virtual reality-based exercise programs and z physical fitness level positive and significantinfluence on Increasing physical activity participation (β=.43, P<.05).

H0: There are no significant gender-related differences in the response to virtual reality-based exercise programs in physical education.

Table 10 *Group Statistics*

	Gender	N	Mean	Std. Deviation	Std. ErrorMean
Virtual reality-basedexercise programs	Male	149	3.9849	.54310	.04449
	Female	126	3.2500	.63403	.05648

Table 11 *Independent Samples Test*

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t-value	df	Sig.(2-tailed)	M Differ-ence	Std. Error Difference
Virtual reality-based exercise programs	Equal Variances Assumed	1.555	.213	10.353	273	.000	.73490	.07098
	Equal Variances Not Assumed			10.221	247.69	.000	.73490	.07190

The above table is the t-test table, in "Levene"s Test for Equality of Variances" there is an assumption of variances of different groups should be equal when mean comparison is done of two different groups, this is the null hypothesis of this test and the alternate hypothesis is variances are not equal across groups. It can be observed that the significant value in this test is higher than 0.05. So, the null hypothesis is failed to reject. So, the null hypothesis of this test can be accepted, when equal variances are assumed, the first-row results are looked into, if the significance value in "Levene's Test for Equality of Variances" is greater than 0.05 then the null hypothesis is rejected, and the second row is considered for the remaining analysis. In this case significance value is greater than 0.05, the first row is considered for the remaining analysis. The t value obtained is 10.221 and the p-value or significance value is 0.00 which is less than 0.05 (significance level of 5%). By observing the t-value which is less than 2 and significance value less than 0.05, we can conclude that the null hypothesis that "There are no significant gender-related differences in the response to virtual reality-based exercise programs in physical education" is rejected, so we must accept the alternative hypothesis. "There are no significant gender-related differences in the response to virtual reality-based exercise programs in physical education".

H0: There are no significant age-related differences in the response to virtual reality-based exercise programs in physical education.

Table 12 *ANOVA*

Virtual reality-based exercise programs					
	Sum of Squares	df	Mean Square	F	Sig.
BetweenGroups	43.880	4	10.970	34.086	.002
Within Groups	86.894	270	.322		
Total	130.774	274			

From the ANOVA test, it is observable that the significance value is 0.000 which is less than 0.05 (at 5% significance level). By observing, ANOVA test we can say that there is a significant difference because the significance value is less than 0.05. So, we fail to reject the null hypothesis "There are no significant age-related differences in the response to virtual reality- based exercise programs in physical education", we must accept the alternative hypothesis. we can conclude that "There is a significant age-related difference in the response to virtual reality-based exercise programs in physical education".

Findings and Discussion

The hypotheses examined in this study aimed to elucidate the potential impact of virtual reality-based exercise programs on students in physical education classes. Our findings provide substantive evidence to reject the null hypothesis concerning the lack of significant effects on physical activity participation, as we observed a clear and statistically significant positive influence of virtual reality interventions in increasing students' engagement in physical activities. Additionally, the study rejected the null hypothesis regarding the absence of a significant impact on physical fitness levels, underscoring the positive and substantial effects of virtual reality-based exercise interventions on enhancing students' physical fitness. Furthermore, our results reject the null hypothesis suggesting no significant influence on motivation and engagement, affirming that virtual reality-based exercise programs have a notable positive influence on fostering motivation and engagement among students in physical education. Moreover, our mediation analysis supports the idea that the positive effect of virtual reality-based exercise programs on physical activity participation is, in part, mediated by increased motivation and engagement. These findings collectively underscore the potential of virtual reality as an effective tool in shaping positive outcomes in physical education, providing not only enhanced physical activity but also improved fitness levels and heightened motivation and engagement among students. This study contributes valuable insights into the multifaceted benefits of incorporating virtual reality into physical education programs, offering implications for educators and

policymakers seeking innovative approaches to promote students' holistic well-being. Our investigation into the impact of Virtual Reality-based Exercise Programs on Physical Activity Participation and Health Outcomes among 275 MBA students yielded compelling findings. Utilizing Structural Equation Modeling (SEM), moderation analysis, ANOVA, and T-tests, our study uncovered a significant positive relationship between the implementation of virtual reality interventions and increased physical activity participation among MBA students Moreover, the analysis revealed noteworthy improvements in health outcomes, with participants exhibiting enhanced physical fitness levels and overall well-being. Interestingly, moderation analysis elucidated certain factors that influenced the effectiveness of virtual realityprograms, offering valuable insights for tailored interventions. Additionally, ANOVA and T- tests exposed nuanced variations within the MBA student sample, emphasizing the importance of personalized approaches in optimizing the impact of virtual reality-based exercise programsin the context of physical education. These findings contribute valuable evidence to the growing body of literature supporting the efficacy of virtual reality interventions in fostering physical activity and promoting health outcomes, particularly within the unique context of MBA education.

4. CONCLUSTION

Based on the results of our study, virtual reality-based exercise programs have demonstrated statistically significant positive effects on multiple aspects of physical education. Firstly, theyexhibit a significant and positive impact on increasing physical activity participation among students in physical education classes ($p < 0.05$). Secondly, these programs show a statistically significant and positive effect on the physical fitness levels of students in physical education ($p < 0.05$). Thirdly, virtual reality-based exercise programs significantly enhance the motivation and engagement of students in physical education ($p < 0.05$). Additionally, our analysis reveals that gender-related differences significantly influence the response to virtual reality-based exercise programs in physical education, with a p-value below 0.05. Similarly, age-related differences are also significant, as indicated by an ANOVA test with a p-value of
0.000. In conclusion, our findings affirm that virtual reality-based exercise programs can be a highly effective tool in enhancing physical education, promoting increased participation, improved physical fitness, and heightened motivation and engagement among students, while also acknowledging the influence of gender and age on program responses.

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