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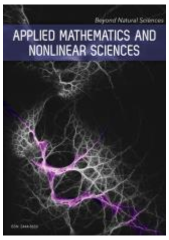

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Modeling the Impact of Virtual Reality Technology Integration for Snow and Ice Sports on Enhancing Regional Sports Tourism Economy

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Abstract

In order to reveal the relationship between the integration of ice and snow sports virtual reality technology and the regional sports tourism economy, this paper establishes a structural equation model for ice and snow sports VR and sports tourism economy. Determine the latent variables and observed variables in the structural equation model (i.e., questionnaire items), take the online distribution of questionnaires to obtain the research data in this paper, and use the model in this paper to explore and analyze the integration of ice and snow sports virtual reality technology and regional sports tourism economies. The questionnaires developed in this paper meet the standard requirements of the reliability test, and the fitting indexes of the model have reached the state of conformity, as shown by the results. The path coefficients of the latent variable (VR experience quality) to the observed variables (Q11, Q12, Q13, Q14) are 0.555, 0.409, 0.344, and 0.348, respectively, and the non-standard coefficient of the quality of ice and snow sports VR experience (Q1) to the local sports tourism economy (Q4) is 0.941, $P<0.05$, which confirms that the ice and snow sports VR experience has a positive impact on the local sports tourism economy promotion effect.

Keywords: VR technology; Structural equation modelling; Latent variables; Observed variables; Sports tourism economy.
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1 Introduction

Although the snow and ice sports have full popularity under the support of the government, the problems existing in the process of its development should not be underestimated. In view of the offline ice and snow sports experience places in the location of remote, limited size and other shortcomings, the importance of online digital technology in ice and snow sports is particularly prominent [1-3]. Virtual reality technology, as a major advanced technology in recent years, can help people realize the purpose of being in a complex virtual environment and allow users to carry out a variety of interactive behaviors with the relevant equipment. Through the use of this technology, people only need to be in a relatively small space. They can enjoy the viewing of ice and snow buildings, experience ice and snow slides, pumping ice monkeys, making ice sculptures and other vivid and interesting recreational sports [4-7]. It can be seen that the combination of virtual reality technology and ice and snow sports can, to a certain extent, make up for the shortcomings of tourists' offline experience place excursion programs [8]. With the 2022 Winter Olympics, the rapid development of ice and snow sports has become an indispensable leisure sport in today's life, and the public's attention to winter sports programs is increasing. People are experiencing a variety of winter sports programs in ice and snow sports tourism, as well as the impact on the economic development of the region [9-12]. Ice and snow tourism projects around China are generally developed by local governments, enterprises or individuals, hoping to drive economic development through ice and snow sports tourism projects, but a series of problems are often encountered in the process of development. Therefore, it is of great significance to increase the government's macro-control efforts, vigorously develop the strategic guiding ideology of ice and snow tourism, and develop the regional sports tourism economy with the help of virtual ice and snow sports in order to promote the multifaceted development of the regional economy [13-16].

In this paper, virtual reality technology is used to construct a virtual ice and snow environment, design interactive experience content, and integrate virtual reality technology with ice and snow sports. The relevant concepts, structures, path diagrams and processes of structural equation modelling (SEM) are described, the questions and contents of the questionnaire are designed, and the latent and observed variables (explicit variables) of SEM are determined. After the confirmation, the questionnaire was formally distributed to get the initial data for this paper, and at the same time, the construction of a structural equation model for the virtual snow and ice sports and regional sports tourism economy was also completed. The initial data was utilized to analyze the demographic characteristics of the sample, and the questionnaire was tested for reliability and validity. Based on the research data, the model of this paper is used to explore the role of ice and snow sports virtual reality technology on the promotion of regional sports tourism economy, draw the variable path diagram, and carry out the significance test of the path.

2 Economic impact of VR on sports tourism in snow and ice sports

2.1 Integrated practice of virtual reality technology in snow and ice sports

2.1.1 Construction of a virtual snow and ice environment

The two most common methods of building virtual environments are 3D modeling and creating 3D panoramas. [17] Designers make 3D modelling. That is, through 3D MAX, Maya, and other model-making software, objects and environments are built and rendered to simulate real-world objects and environments. In the construction of a snow and ice environment, modelling takes the drawing plane as the entrance of the object, and the snow and ice terrain is rendered by adjusting the parameters in the material editor. The snowfall special effect cannot be created without the placement of special noise particles. Photographers shooting 3D panoramas often need to match 360° panoramic cameras, heads, tripods, and other equipment to achieve the purpose of presenting people with a high sense of reality. However, a few devices can also capture panoramic views, such as the B-Station video creator, who cleverly used a drone's 360° photography feature to film the ice and snow world in its entirety.

2.1.2 Designing the content of the interaction experience

Achieving high participation and high interactivity of the project is an important way to help the ice and snow entertainment virtual reality project to widely accept users, and the quality interaction design experience cannot be separated from the use of 3D development tools and interactive devices.

1) Software

   On the software level, the 3D engine undertakes the production of the virtual reality world and meets the function of user interaction, and engines such as Unity 3D and Unreal engine are often used in the development of virtual reality ice and snow recreation sports projects. These engines can not only build virtual snow and ice environments, but also set up C# or JavaScript to achieve interactive behavior within the environment. The physics of the objects in the project can be done by NVIDIA Physx technology, which allows the designer to simulate the realistic physics of the objects without the need to set up an additional physics engine.

2) Hardware

   At the hardware level, virtual reality devices are mainly composed of input and output devices. Input devices are used to input the movements issued by the user so as to ensure timely interaction between the human and the computer. Common input devices include a 3D position tracker, handle, and data glove. The handle is one of the most representative input devices when people experience the ice and snow recreation virtual reality project, which is capable of user hand positioning and real-time feedback of human-computer interaction and has great flexibility. However, the most suitable output device is the data glove, which is able to real-time track the human body and detect multiple complex movements.

   The output equipment is used to simulate the real feeling of the human body and provide user information feedback. The main equipment includes graphic display equipment, sound display equipment, and haptic feedback equipment. In order to provide users with a richer and more diverse experience, some virtual reality experience halls even specialize in developing exquisite virtual reality seats, which can not only be lifted up and down and swayed left and right with the rhythm of the game but also release cold and hot air through the jet device to set off the game atmosphere. Therefore, even in the indoor experience hall, visitors can still nervously ride the "ice and snow roller coaster", can "ride reindeer", can "skate", and anyone who is in the virtual entertainment sports will feel as if they are in the vast ice and snow, full of realism, participation and experience.

2.2 Structural equation modelling

Structural equation modelling (SEM) is a mathematical equation that includes structural and measurement equations, with structural equations expressing the relationship between latent variables and measurement equations expressing the relationship between latent variables and indicators [18]. Its model construction, evaluation, correction and path analysis are state-of-the-art statistical analysis techniques, and structural equation modelling is capable of accurately analysing the impact of individual indicators on the aggregate as well as the relationship between individual indicators.

2.2.1 Components of structural equation modelling

1) Explicit variables: usually indicators are variables that are directly measured, hence the term observed variables [19]. In Amos represents, a rectangle represents conformity.

2) Latent variables: variables that cannot be measured directly with data, called hidden variables [20]. It is measured indirectly through the design of several different indicators. In Amos, latent variables represent an ellipse representing conformity.

3) Error variables usually refer to variables that are not actually measurable. The explicit variables cannot fully explain the implicit variables, so the error that must exist is the error variable in structural equation modelling. There must be an error variable for every explicit variable. In Amos, the error variable represents conformity represented by a circle.

4) Degree of fit, also called fitness and compatibility, is the degree of fit between the theoretical model assumed in the thesis and the actual data [21]. At the same time, it is an important index in structural equation modelling. The higher the model fit, the higher the fit between the theoretical model and the actual data is represented. In Amos the chi-square value is one of the fit test indicators, general standard $P>0.05$. Because the chi-square value is easily affected by the sample size, the other fitness indicators are judged together more accurately.

5) Path coefficient: The path coefficient tests the significance of the correlation between significant variables. Path coefficients contain both standard and non-standard path coefficients. We usually use the standard coefficient. Its value is generally not greater than 1. $P>0.05$ in the test process, indicating that the path between the two variables is not significant. Deletion can be done to improve the model fit.

6) Exogenous variables: variables that only play an explanatory role in the model. They only affect other variables and are not affected by other variables. In a path diagram, only the arrows point to other variables, and no arrow points to it.

7) Endogenous variables: variables that are influenced by other variables in the model, including exogenous and endogenous variables. In a path diagram, the only arrows are for other variables, and there are no arrows for it.

2.2.2 Structure of structural equation modelling

Structural equation modelling (SEM) type consists of two types of matrix equations. One, structural equations are used to express the relationship between latent variables, also known as causal models, and are used to test the research hypotheses of the model. The second measurement equations are used to express the relationship between the latent and explicit variables, also known as the validated factor analysis model, which is used to test the reliability and validity of the model. Indicators that allow structural equation modelling contain characteristics other than random and systematic error, i.e., measurement of misbehaviour and measurement of latent variables.

Structural equation modelling typically consists of three matrix structures expressing equations:

1) Structural model

Structural model mathematical expression:

$$\eta = B\eta + \Gamma\xi + \zeta \quad (1)$$

Where η denotes the endogenous latent variable, ξ is the exogenous latent variable, B is the path coefficient, which denotes the relationship between the endogenous latent variables, Γ is the path coefficient, which denotes the effect of the exogenous latent variable on the endogenous latent variable, and ζ is the residual term of the structural equation, which reflects the unexplained portion in the equation.

2) Measurement model

Measurement model mathematical expression:

$$Y = \wedge y\eta + \varepsilon \quad (2)$$

$$X = \wedge x\xi + \delta \quad (3)$$

Where X is the exogenously observed variable, Y is the endogenously observed variable, $\wedge x$ the direct relationship between the exogenously observed variable and the exogenous latent variable is the factor loading matrix of the exogenously observed variable on the exogenous latent variable, $\wedge y$ is the relationship between the endogenously observed variable and the endogenous latent variable is the factor loading matrix of the endogenously observed variable on the endogenous latent variable, δ is the error of exogenously observed variable X , and ε is the error of endogenously observed variable Y .

2.2.3 Steps in structural equation modelling to construct the indicator system

Structural equation modeling (SEM) is divided into latent variables for abstract concepts and explicit variables for measurement indicators. Arrows are used to point to dimensions and measurement indicators, not to concepts. Thus, concepts can be considered endogenous latent variables, dimensions can be considered exogenous latent variables, and indicators can be considered exogenous explicit variables. The process of constructing the indicator system using structural equation modelling technique is very rigorous, and the whole process is decomposed into the following steps:

1) The possible dimensions are first listed, and then the measurement indicators are built to form a unique indicator system. Since the researcher analyzes different industries or enterprises, the indicator system constructed for the same concept may be different, which is also known as the competition model.

2) Forming preliminary scales and questionnaires.

3) According to the answers to the questions of the expert consultation and interview communication, add or delete certain questions to modify the scale and design the questionnaire.

4) Data collection mainly in the form of online questionnaire star.

5) Different competing models were adapted, evaluated and modified using structural equation modelling techniques to finally find the most appropriate model.

6) Dimension measurements and index weights, based on a combination of the best model and goodness-of-fit indicators, etc., were derived.

2.3 SEM-based impact of snow and ice sports on sports tourism

2.3.1 Questionnaire design

According to the established research focus, the searched References were read, analysed and organised, and these were combined with the themes and issues explored in this paper, and a preliminary questionnaire was prepared based on the well-established scales of the theory of leisure constraints, selecting the measurements suitable for this study. The survey sample's basic information is gathered in the first part, with sections on gender, occupation, income, and the arrangement of free time. The second part is the survey sample's cognitive mediation of the sports tourism economy based on ice and snow sports virtual reality technology, which includes the parts of VR experience quality, tourists' satisfaction, tourism consumption willingness, and regional sports tourism economy. The third part is the survey on the influence factors of the sports tourism economy based on ice and snow sports virtual reality technology, which is in the form of a Likert scale, which is divided into five levels, namely, completely agree, agree, generally, disagree, and completely disagree, respectively, and the scores are in the order of 5-1.

2.3.2 Identification of research variables

Based on the theory of structural equation modeling and the integration of VR technology for ice and snow sports, the observed variables and potential variables in the structural equation model have finally been determined. The latent variables include ice and snow sports VR experience quality, tourist satisfaction, tourism consumption willingness, and regional sports tourism economy, while the observed variables are for each latent variable involving specific measurement items.

2.3.3 Designing measurement items for observed variables

Multiple observational variables (i.e., questionnaire items) were designed for each latent variable to ensure the reliability and validity of the measure.

1) Quality of VR experience (Q1)

   Question item Q11: Realism of VR content.

   Question item Q12: Interactivity of VR.

   Question item Q13: Ease of use of VR.

   Question item Q14: Diversity of VR scenes.

2) Visitor satisfaction (Q2)

   Question item Q21: Overall satisfaction with the VR experience.

   Question item Q22: Satisfaction with the application of VR technology in snow and ice sports.

   Question item Q23: Whether willing to recommend to others.

3) Willingness to spend on tourism

Question Q31: Willingness to consume after participating in VR ice and snow sports.

Question Q32: Willingness to purchase related tourism products.

Item Q33: Willingness to visit again in the future.

4) Regional Sports Tourism Economy

Question Q41: Changes in local snow and ice tourism revenue.

Item Q42: Development of related industries driven by ice and snow tourism.

Item Q43: Impact of snow and ice tourism on local employment.

2.3.4 Distribution of questionnaires

Before the formal survey of this study, a small pre-survey was conducted to test the questionnaire and ensure the rigor and scientificity of the study. The purpose of this pre-survey was to collect feedback and results from the questionnaire distribution and retrieval process so that the questionnaire could be modified to improve the scientificity of the questionnaire design and the retrieval effect so that the respondents could have a clearer understanding of the contents of the survey, and to lay a solid foundation for the smooth conduct of the follow-up survey. The questionnaire sent out in this preliminary survey is a questionnaire developed after consultation and consultation in the expert opinion, after SPSS22.0 on the valid questionnaires recovered this time for the questionnaire logic and content of the testing and analysis, according to the results of the reliability test and validity test, the validity of the weak title of the grammatical adjustments to the measurement of the questionnaire items were deleted, the questionnaire was amended, the preparation of the formation of the second round of the Questionnaire. After each round of the survey, it was analysed by SPSS22.0 to observe its reliability, validity, correlation, etc., and the official questionnaire was finally formed according to the conclusions of the analysis.

The formal research phase used the official questionnaire that was revised from previous research. The data was obtained by randomly distributing the questionnaires. The location of the questionnaires was Area A, and the time of distribution was from September 2023 to December 2023. 498 questionnaires were recovered through online distribution, etc. All the recovered questionnaires were examined, and questionnaires with too short a response time and significant regularity of the answers or questionnaires whose contents were obviously untrue were excluded, and a total of 489 valid questionnaires were recovered. The effective recovery rate was 98.19 per cent, resulting in the collection of 489 valid questionnaires.

3 Analysis of examples

3.1 Demographic characterisation of the sample

According to the distribution of questionnaires to obtain research data, the demographic characteristics of the sample were analysed, and the results of the demographic characteristics analysis of the sample are shown in Figure 1. The sample's basic information is represented by the vertical axis and the horizontal axis, while the four modules above represent gender, occupation, income, and free time categories. The labels in the figure show that the number of male students is

273 (55.83%), while the number of female students is 216 (44.17%). In the occupational category, the number of teachers (172) and civil servants (130) is high, while the number of other occupations is less distributed. The number of people with an income of 10,000 yuan is 166, which is much higher than the number of people with other incomes, and in terms of free time arrangements, most of the people are concentrated in one month (146 people) and half a month (136 people).

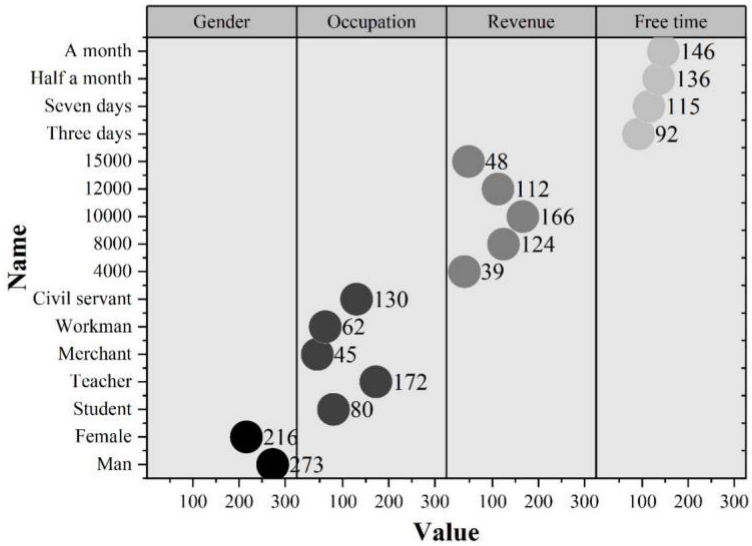

Figure 1. Sample demographic characteristics analysis results

3.2 Reliability test

Credibility, also known as reliability, refers to the degree of credibility of the questionnaire, which mainly reflects the consistency, reproducibility, and stability of the test results. In scientific measurement tools, the same thing is repeatedly measured many times. The results should always remain the same to be credible. There are many ways to measure the intrinsic reliability of the scale. In this paper, we use the Kronbach coefficient (α coefficient) to represent the consistency reliability within the scale, and the results of the reliability test are shown in Table 1. The value of α is between 0 and 1. When the value of α is higher, it means that the results of the items in the questionnaire tend to be more consistent, which means that the reliability of the scale is better. When the coefficient of α is lower than 0.6, the reliability is low, and it is necessary to consider reformulating the questionnaire or screening the questionnaire for controversial indicators, and the coefficient of α is higher than 0.9, which indicates that the results of the questionnaire data are very stable, and the reliability is very high. A coefficient of α between 0.7 and 0.8 is relatively stable and has considerable reliability. Based on the performance of the data in the table, it can be seen that the reliability values of the question items of the 13 designed observational variables are 0.836 to 0.948, and the reliability values of each observational variable are between 0.855 and 0.889. Based on the high stability of the test results, it can be concluded that the question items of the designed observational variables are more reliable.

Table 1. Reliability test results

Observed variable	Item	Symbol	The reliability coefficient of the item	The reliability coefficient of the variable
Q1	The fidelity of VR content	Q11	0.842	0.889
	VR interactivity	Q12	0.887	
	The ease of use of VR	Q13	0.921	
	Diversity of VR scenarios	Q14	0.907	
Q2	Overall satisfaction with VR experience	Q21	0.853	0.855
	The application satisfaction of VR technology in ice and snow sports	Q22	0.816	
	Would you like to recommend it to others	Q23	0.897	
Q3	Participate in the consumption will of VR ice and ice sports	Q31	0.885	0.883
	The willingness to buy related tourism products	Q32	0.948	
	The will to visit again in the future	Q33	0.817	
Q4	Local snow and ice tourism income changes	Q41	0.846	0.848
	The development of related industries driven by snow and ice tourism	Q42	0.836	
	The impact of snow and ice tourism on employment	Q43	0.861	

3.3 Validity tests

The exploratory factor analysis process can judge the validity index of the scale. In the exploratory factor analysis results, when KMO>0.6 and Bartlett's test of sphericity significance P<0.05, then it indicates that the questionnaire is well suited for principal component analysis (factor analysis). When 0.8<KMO<0.9, it is well suited. When 0.7<KMO<0.8, it is generally suited. Acceptable when 0.6<KMO<0.7. Unsuitable for factor analysis when KMO<0.6. The results of KMO and Bartlett's test for the scale are shown in Table 2. From the data in the table below, it can be seen that the result of this factor analysis KMO=0.853>0.6 and the result of Bartlett's test of sphericity P=0.003, which meets the condition of P<0.05, indicating that the questionnaire is suitable for factor analysis.

Table 2. KMO and bartlett test results of the scale

KMO sampling availability number	0.853	
Butterley ball test	Approximate card	10819.057
	Freedom	111
	Significance	0.003

The results of the common factor variance extraction are shown in Table 3. Through the extraction test on the results of influencing factors' common factor variance extraction, the values of the common factor variance of the scale items within the questionnaire are all greater than 0.6, which indicates that the extracted common factors can scientifically represent the information of the original variables.

Table 3. Extraction results of common factor variance

Item	Symbol	Initial	Extraction
The fidelity of VR content	Q11	1.000	0.769
VR interactivity	Q12	1.000	0.823
The ease of use of VR	Q13	1.000	0.859
Diversity of VR scenarios	Q14	1.000	0.841
Overall satisfaction with VR experience	Q21	1.000	0.788
The application satisfaction of VR technology in ice and snow sports	Q22	1.000	0.843
Would you like to recommend it to others	Q23	1.000	0.821
Participate in the consumption will of VR ice and ice sports	Q31	1.000	0.753
The willingness to buy related tourism products	Q32	1.000	0.832
The will to visit again in the future	Q33	1.000	0.835
Local snow and ice tourism income changes	Q41	1.000	0.81
The development of related industries driven by snow and ice tourism	Q42	1.000	0.896
The impact of snow and ice tourism on employment	Q43	1.000	0.883

The total variance explained by the influencing factors through the maximum variance rotation method for factor scores is shown in Table 4. From the results of the table below, it can be seen that the initial eigenvalues of the first to fourth components of the influencing factors are 5.049, 2.705, 2.024 and 1.416, respectively, and their initial values are all greater than 1. According to the cumulative percentage values in the table, it can be seen that the cumulative total variance of explanation of the four principal components of the influencing factors in the questionnaire scales is 79.76 per cent, which is greater than 60 per cent, which means that the data of the scales in the questionnaire has a good effect of explanation.

Figure 2 shows the fragmentation plot, which indicates that the fragmentation plot has an inflection point at the fourth component, which indicates that the first four co-factors have the greatest change. So, this study selects four components at the factor level. The extraction of the four cofactors through principal component analysis and the gravel plot fully meets the criteria designed in the questionnaire and matches the conceptual model constructed in the theoretical study.

Table 4. The total variance of the factors explained

Constituent	Initial eigenvalue			Extracting the load of the load		
	Total	Percentage of variance	Accumulated	Total	Percentage of variance	Accumulated
1	5.049	35.98%	35.98%	5.049	35.98%	35.98%
2	2.705	19.27%	55.25%	2.705	19.27%	55.25%
3	2.024	14.42%	69.67%	2.024	14.42%	69.67%
4	1.416	10.09%	79.76%	1.416	10.09%	79.76%
5	0.507	3.61%	83.38%			
6	0.434	3.09%	86.47%			
7	0.426	3.04%	89.50%			
8	0.343	2.44%	91.95%			
9	0.311	2.22%	94.16%			
10	0.239	1.70%	95.87%			
11	0.217	1.55%	97.41%			
12	0.194	1.38%	98.80%			
13	0.169	1.20%	100.00%			

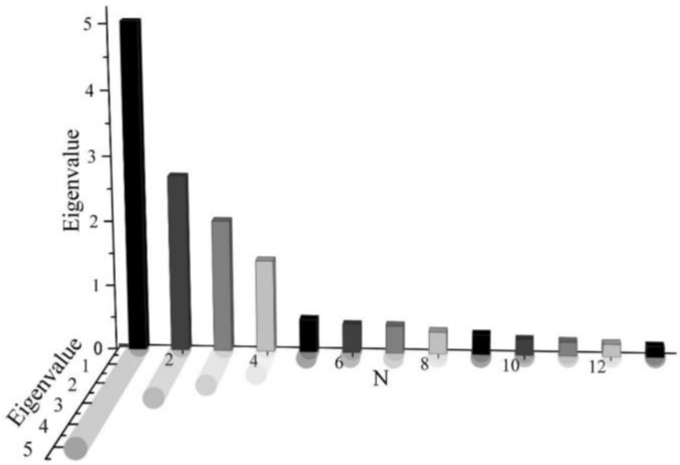

Figure 2. Rubble map

The factors were rotated using the maximum variance method based on the variables in this study, and the results of the rotated factor loadings are presented in the table below. The values with a loading value lower than 0.5 were deleted from the table for ease of observation, and the results of the validity test are shown in Figure 3. The table data shows that every factor indicator is associated with its respective dimension and has a loading value below 0.5 in another dimension. The four principal components correspond to the four variables of VR experience quality, tourists' satisfaction, tourism consumption willingness, and the regional sports tourism economy, and the factor loadings of the corresponding question items of each principal component are all above 0.5. All the question items in the questionnaire were retained, and it shows that each question item responds well to the information of the variable to which it belongs. The questionnaire exhibits excellent differentiation and aggregation.

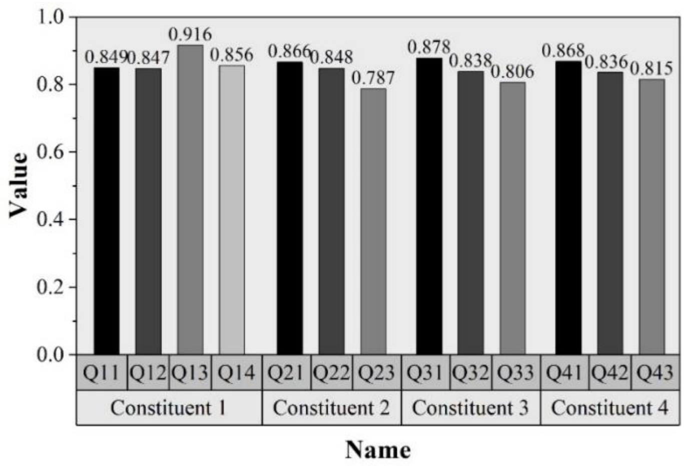

Figure 3. Validity test results

3.4 Model path diagram and goodness-of-fit test

The data table obtained from the above questionnaire was imported into AMOS22.0 software for calculation and estimation to obtain the main fitness index test results, and the fitness index test results are shown in Table 5. As can be seen from the table, the output of X^2/DF is 0.154, which is a good fit within the range of evaluation criterion 3. RMSEA is also an important indicator of model fitness test results, and in general, it is evaluated as follows: if RMSEA>0.1 indicates that the model is poorly fitted; 0.08-0.1 indicates that the model is still okay, with a general fit; 0.05-0.08 indicates that the model is well fitted; RMSEA<0.08 indicates that the model is well fitted; RMSEA<0.1 indicates that the model is good, and RMSEA<0.1 indicates that the model is good. Good.RMSEA<0.05 indicates that the model fit is very good. Among them, the model fit indices GFI, NFI and CFI, where the index AGFI was adjusted so that the data values of the four fit indices were all in the range of 0-1, and the closer to 1, the better the model fit. It is commonly believed that if their values exceed 0.8, it can indicate that the data's fit to the theoretical model is acceptable. The important fitness evaluation indicator, the chi-square degrees of freedom ratio (X^2/DF), meets the desirable criteria, and the rest of all the observed variables are in the test indicators of fit, and all of them have reached the state of conformity.

Table 5. Fitness index test results

Inspection index	Fitness criteria	Output result	Whether or not
X^2/DF	<3.0	0.147	Coincidence
RMESA	<0.1	0.087	Coincidence
GFI	>0.8	0.907	Coincidence
NFI	>0.8	0.877	Coincidence

Figure 4 shows the path diagram of the estimated output of the model computation, and it can be seen that the path coefficients of the latent variable (VR experience quality) on the observed variables (Q11, Q12, Q13, Q14) are 0.555, 0.409, 0.344, 0.348, respectively, while the error terms of the observed question terms (Q11, Q12, Q13, Q14) are 0.453, 0.735, 0.479, and 0.534, and the same is true for the other three latent variables, which will not be repeated. The path coefficients between the latent variables can also be seen, and the path coefficients between the quality of VR experience (Q1), tourists' satisfaction (Q2), willingness to spend on tourism (Q3), and the regional sports tourism economy (Q4) are 0.447, 0.551, and 0.411, respectively, which reveals the interactive relationship between the quality of VR experience, tourists' satisfaction, willingness to spend on tourism, and the regional sports tourism economy.

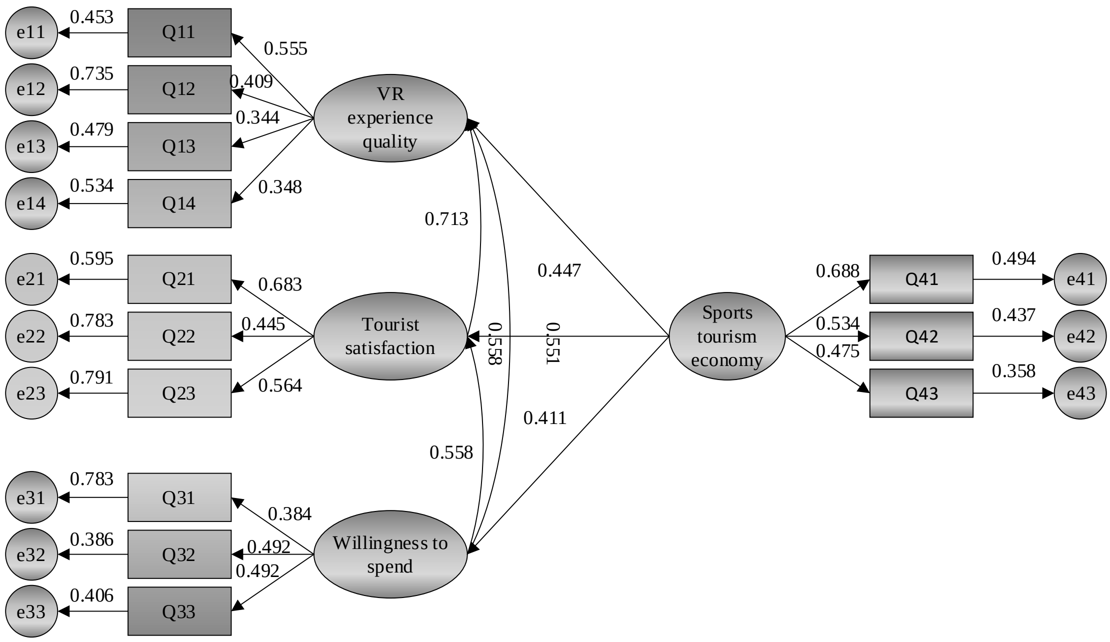

Figure 4. The model calculates the output path

3.5 Significance test for path

The output plot of the above model results is preliminary, and then the significance of each path coefficient must be tested against the output, and it is necessary to analyse the relationship between the latent variable and its observed variable. The significance between two observed variables can be indicated by using the P-value or C.R. index in path analysis. For the relationship between two observed variables to be significant, then the data P-value should be less than 0.01, indicated by '***'. If the P-value is not in this range, it indicates that the paths are not significant and the paths need to be optimised. At this point, it is necessary to adjust the critical value of C.R.. If the value of C.R. is greater than 0.05, within this range, it indicates that the path is significant at the critical value of 0.05. Due to the limited space to analyse the path significance test between latent variables and observed variables, the path significant relationship between latent variables, and the path significance test between observed variables is too cumbersome to outline in detail. The principle is the same.

Firstly, the path significance test between latent variables and observed variables is analysed, and the results of the significance test between specific latent variables and observed variables are shown in Table 6, where Estimate is the unstandardized coefficient, S.E is the standard error, C.R. is the combined reliability, and P is the result of the significance test. As can be seen from Table 6, among all the path significant test results, the diversity of VR scenes (Q14) → quality of ice and snow sports VR experience (Q1) has the largest unstandardised coefficient (0.992), the standard error value of 0.0753, and the value of the combined reliability is 8.756, and it satisfies P (0.027)<0.05, which concludes that the diversity of VR scenes and the quality of ice and snow sports VR experience have a significant correlation, and others are the same.

Table 6. Significant test results between latent variables and observation variables

Path	Estimate	S.E.	C.R.	P	Is it significant
Q11→Q1	0.843	0.0753	8.756	0.027	Yes
Q12→Q1	0.968	0.0729	9.426	0.047	Yes
Q13→Q1	0.947	0.0871	8.857	0.009	Yes
Q14→Q1	0.992	0.0884	8.526	0.014	Yes
Q21→Q2	0.816	0.0877	9.794	0.029	Yes
Q22→Q2	0.952	0.0704	9.214	0.004	Yes
Q23→Q2	0.804	0.0838	7.319	0.008	Yes
Q31→Q3	0.917	0.0865	8.784	0.042	Yes
Q32→Q3	0.866	0.0809	7.618	0.039	Yes
Q33→Q3	0.921	0.0751	9.145	0.025	Yes
Q41→Q4	0.905	0.0753	8.893	0.037	Yes
Q42→Q4	0.933	0.0879	9.361	0.047	Yes
Q43→Q4	0.988	0.0853	9.957	0.017	Yes

After analysing the path significance test between the analysed latent variables and the observed variables, the path significance test between the latent variables was then analysed, and the results of the path significance test between the latent variables are shown in Table 7. The non-standardised coefficient of the quality of ice and snow sports VR experience (Q1) and the local sports tourism economy (Q4) is the largest, with a specific value of 0.941, and the corresponding standard error and combined reliability are 0.0716 and 0.954, respectively, with P<0.05, i.e., the quality of the ice and snow sports VR experience is significantly correlated with the local sports tourism economy at the 0.05 level.

Table 7. The path significance test results between latent variables

Path	Estimate	S.E.	C.R.	P	Is it significant
Q1→Q2	0.911	0.0716	9.544	0.043	Yes
Q1→Q3	0.832	0.0844	9.986	0.043	Yes
Q1→Q4	0.941	0.0899	8.642	0.046	Yes
Q2→Q3	0.824	0.0768	7.434	0.002	Yes
Q2→Q4	0.915	0.0794	9.248	0.031	Yes
Q3→Q4	0.843	0.0842	8.813	0.006	Yes

4 Conclusion

With the help of structural equation modelling, this topic explores the role of ice and snow sports virtual reality technology in promoting the regional sports tourism economy. Starting from the research objectives, the questionnaire used to obtain the research data was designed, and the quality of ice and snow sports VR experience, tourist satisfaction, tourism consumption willingness, and regional sports tourism economy were set as the latent variables of the structural equation modelling, while the corresponding observational variables were the test items of the questionnaire. In the path significance test between all the latent variables and the observed variables, the unstandardised coefficient of the diversity of VR scenes → quality of ice and snow sports VR experience is the largest (0.992), and there is a significant positive correlation between the two. VR experience quality and local sports tourism economy have the most significant positive correlation with a non-standardised coefficient of 0.941 in the path significance test between latent variables. This paper strengthens people's knowledge of ice and snow sports virtual reality technology and the regional sports tourism economy, and promotes the development of the regional sports tourism economy.

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