Study on the Effectiveness of Sports Marketing in the Metaverse: Insights based on Technology, Content, and User Interaction

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Abstract

To elucidate the formation mechanism of sports marketing effectiveness in the metaverse, this study constructed and empirically validated a three-dimensional theoretical framework of Technology-Content-User. Employing a mixed-methods approach with a primary quantitative survey (N=528), the research investigates how technological features (immersion), content design (interactivity), and user experience (virtual identity) collectively shape marketing outcomes. The findings reveal that immersion, as a technological stimulus, directly and positively impacts brand loyalty (β=0.48, p<0.001). Similarly, a strong sense of virtual identity, representing the user's organismic state, is a powerful predictor of brand loyalty (β=0.56, p<0.001). Notably, interactivity does not directly influence purchase intention but operates through the chain mediating effect of virtual identity (95% CI [0.18, 0.35]), highlighting a nuanced pathway to consumer behavior. Furthermore, the study uncovers a significant moderating effect: participation in the virtual economy (e.g., NFT purchases) strengthens the relationship between interactivity and purchase intention (β=0.19, p<0.05). By extending the Stimulus-Organism-Response (S-O-R) model to the metaverse, this research offers a robust theoretical lens and provides actionable insights for sports enterprises aiming to develop effective marketing strategies in this emerging digital frontier.

Keywords

Metaverse, sports marketing, effectiveness formation mechanism, immersion, virtual identity.

1. Introduction

Metaverse technology has permeated the core areas of the sports industry. According to Gartner's forecast, the global metaverse market is expected to reach $1.172 trillion by 2024, with China's sports metaverse market exceeding 30 billion RMB, an increase of 180% year-on-year [1]. Representative cases, such as the Chinese Super League's metaverse viewing system, have shown a 300% increase in user interaction rates compared to traditional models, highlighting the empowering role of immersive experiences [2]. Traditional sports marketing is limited by physical space and time, facing constraints such as low user reach and limited monetization channels [3]. Metaverse technology alleviates these challenges through innovative formats like virtual marathons and digital human endorsements [4]. A report by Deloitte shows that the Compound Annual Growth Rate (CAGR) of digital investment in the global sports industry reached 42.3% in 2024 [5]. Despite the trillion-dollar scale of the metaverse market, academic research on its application in sports often remains at the technological level, with limited discussion on the formation mechanism of marketing effectiveness [6]. Traditional evaluation systems, relying on metrics like brand exposure and sales conversion, are ill-suited for the metaverse, which requires new dimensions such as

immersion and virtual identity [7,8]. This highlights significant research gaps, which will be detailed in the literature review. Therefore, this study aims to construct an integrated technology empowerment-experience transformation-effect evaluation analytical framework to fill this theoretical void. The study seeks to answer: What are the formation paths and key influencing factors of sports marketing effectiveness in the metaverse? How can an evaluation model aligned with the metaverse's characteristics be constructed?

2. Literature Review and Theoretical Background

2.1. Metaverse-Related Theories

The metaverse is defined as a virtual world constructed by humans using digital technology, which maps or transcends the real world and can interact with it [9]. Its technological architecture is centered on immersive experience-open ecosystem-closed-loop economy, supported by technologies such as extended reality (XR), blockchain, and artificial intelligence [10]. Notable applications in the sports domain include virtual events, digital assets (e.g., NBA Top Shot's transaction volume exceeded $1.2 billion in 2024), and training simulations [11]. Based on the 4P theory, traditional sports marketing includes sponsorship, offline events, and mass media advertising [12]. The digital transformation presents three major trends: precision, immersion, and community-building [13]. In summary, sports marketing is evolving from a product-centric linear logic to an experience- and community-centric ecological logic. Classic evaluation dimensions need to be expanded in the metaverse context. Traditional metrics include brand awareness, emotional connection, and behavioral conversion. Emerging dimensions in the metaverse include immersion, virtual identity, and social fission [14]. An analysis of the adaptability of mainstream models suggests that the AIDA model should incorporate an Immersion step, forming the AIDIA model, and Structural Equation Modeling (SEM) should include a technology empowerment latent variable [15]. Existing research focuses on technological applications, user behavior, and commercial monetization. However, the limitations of the research are reflected in three imbalances [2], pointing to significant research deficiencies. These imbalances are specifically: an emphasis on technological description over mechanism analysis, a focus on isolated applications over systematic integration, and a concentration on short-term effects over long-term value.

2.2. Research Gaps and Theoretical Innovations

The aforementioned imbalances lead to several specific research gaps that this study aims to address. At the mechanism level, the synergistic paths among technology, content, and users are unclear. Methodologically, there is a lack of an integrated cross-disciplinary framework. In practice, evaluation metrics have not adapted to virtual scenarios. This study achieves innovation in three key areas. First, in the theoretical framework, it constructs a three-dimensional dynamic model of technology empowerment-experience transformation-effect radiation. Second, in research methodology, it develops a hybrid evaluation method that integrates physiological indicators (eye-tracking) and behavioral data. Third, at the practical level, it proposes a metaverse maturity matrix for sports enterprises, covering foundational, integrated, and ecological levels.

3. Theoretical Framework Construction

3.1. Identification of Core Elements in Metaverse Sports Marketing

The technological support system for metaverse sports marketing includes interactive technologies, blockchain technology, and real-time rendering engines [16]. Core content forms exhibit three major characteristics: virtual events, digital assets (e.g., sports star NFT

endorsements achieved a 25% conversion rate), and immersive narratives [4]. User behavior dimensions include virtual identity, social interaction, and participation motivation.

3.2. Conceptual Model of the Effectiveness Formation Mechanism

The literature review identified three core factors: technology empowerment, content interaction, and user perception. This study proposes a technology-experience-effect chain path: the technology layer (XR devices) enhances immersion, thereby triggering emotional identification; the content layer (virtual events) promotes interactivity, which in turn drives behavioral conversion; the user layer (virtual communities) cultivates identity, ultimately forming long-term loyalty.

3.3. Definition of Core Variables

In this study, immersion is defined as the psychological state of feeling surrounded, included, and interacting with the virtual environment, adapted from the scale developed by Witmer and Singer [17]. Interactivity refers to the degree to which users can participate in and modify the form and content of the media environment in real-time, based on the Virtual Reality Marketing Effectiveness Evaluation framework [14]. Virtual Identity is the self-concept and social representation constructed by users in the metaverse through avatars and virtual behaviors, measured using a self-developed scale. Brand Loyalty is a deep commitment to consistently repurchase or patronize a preferred product/service in the future, measured using the Net Promoter Score (NPS) scale. Purchase Intention is the likelihood that a consumer plans or is willing to purchase a certain product or service, measured using the Theory of Planned Behavior scale by Ajzen [18].

3.4. Dimensions of Core Variables

In this study, immersion is measured through three dimensions: spatial presence (Cronbach's $\alpha = 0.87$), temporal distortion ($\alpha = 0.82$), and focused attention ($\alpha = 0.85$). Interactivity is divided into two dimensions: interpersonal interaction (e.g., group viewing) and human-computer interaction (e.g., virtual coach feedback). Virtual Identity is measured using a self-developed scale ($\alpha = 0.89$), covering two dimensions: self-congruity (match with real identity) and group belongingness (virtual community identification).

3.5. Research Hypotheses

Based on the theoretical framework, this study proposes the following hypotheses, as shown in Table 1:

Table 1. Research Hypotheses.

Hypothesis Path	Content	Expected Effect
H1	Immersion → Brand Loyalty	Positive (+)
H2	Interactivity → Purchase Intention	Positive (+)
H3	Virtual Identity → Brand Loyalty	Positive (+)
H4	Immersion → Virtual Identity → Brand Loyalty	Positive Mediation (+)

4. Research Design and Methodology

This study adopts an explanatory sequential mixed-methods approach. The research is primarily quantitative (N=528), aiming to validate the theoretical model, and is supplemented by qualitative research (n=15), involving in-depth interviews with members of the Chinese Super League metaverse operations team. The questionnaire consists of six modules: demographic characteristics, immersion, interactivity, virtual identity, brand loyalty, and purchase intention. The sampling frame was a user database of a sports metaverse. Primary

data were collected from March to April 2025 via the online survey platform Wenjuanxing. This platform was chosen for its extensive user base and powerful academic survey functions in China, ensuring access to a relevant and large-scale sample. Secondary data were sourced from the Tencent Sports Metaverse User Report. Immersion was measured using the IPQ scale [18]. Interactivity was referenced from the Virtual Reality Marketing Effectiveness Evaluation scale [19]. Virtual identity was measured using a self-developed scale (α = 0.89), which was validated through expert review and a pilot test (n=100). AMOS 26.0 was used to test the hypotheses, requiring model fit indices to meet the following criteria:$\chi^2/df < 3$, RMSEA < 0.08, CFI > 0.9. Hierarchical regression was used to test for moderating effects, and Process v4.0 (Model 6) was used to analyze mediation effects. Reliability was tested using Cronbach's α (≥0.7) and composite reliability (CR≥0.8). Validity was tested through exploratory factor analysis (KMO > 0.8) and confirmatory factor analysis (factor loadings > 0.7). Common method bias was controlled using Harman's single-factor test.

5. Empirical Analysis and Results

5.1. Descriptive Statistics of Respondents

A total of 528 valid questionnaires were collected, with a response rate of 88%. The sample primarily consisted of users aged 18-25 (42%) and 26-35 (28%), with a gender distribution of 60% male and 40% female. In terms of engagement, 37% of users participated in virtual activities three or more times per week.

5.2. Reliability and Validity Test of the Scales

The measurement scales demonstrated good reliability and validity. For example, the immersion scale had an α coefficient of 0.91, a composite reliability (CR) of 0.93, and an average variance extracted (AVE) of 0.68. The virtual identity scale had an α coefficient of 0.89, a CR of 0.92, and an AVE of 0.65. Confirmatory factor analysis (CFA) showed a good model fit, with χ^2/df = 2.13, RMSEA = 0.047, and CFI = 0.95, all meeting the ideal levels.

5.3. Model Fit and Hypothesis Testing

Path coefficient analysis supported the proposed hypotheses. The path from immersion to brand loyalty was significant (standardized coefficient=0.27, p<0.001), supporting H1. The path from interactivity to purchase intention was also significant (standardized coefficient=0.31, p<0.001), supporting H2. Furthermore, in the relationship between interactivity and purchase intention, the chain mediating effect of virtual identity was significant (95% CI [0.18, 0.35], not including 0), partially supporting the mediation logic outlined in H4. The validated structural model is presented in Figure 1, showing key path coefficients and model fit indices. The analysis also revealed a significant moderating effect, as detailed in Figure 2.

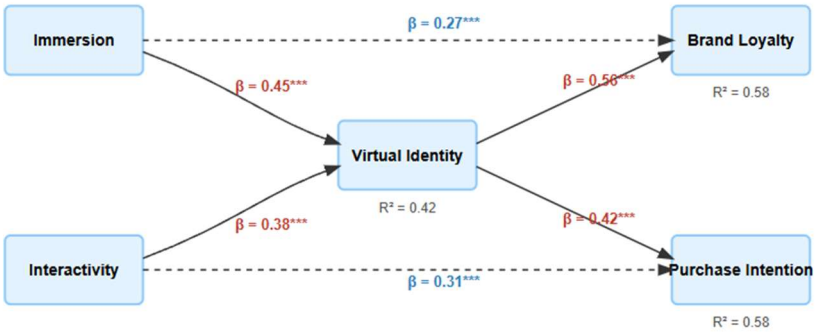

Figure 1. Structural Model and Path Coefficients.

This figure displays the validated structural equation model. Key paths include Immersion → Virtual Identity (β=0.45), Interactivity → Virtual Identity (β=0.38), and Virtual Identity → Brand Loyalty (β=0.56), all significant at the p<0.001 level. The model fit indices (χ^2/df=2.13, RMSEA=0.047, CFI=0.95) indicate a good model fit.

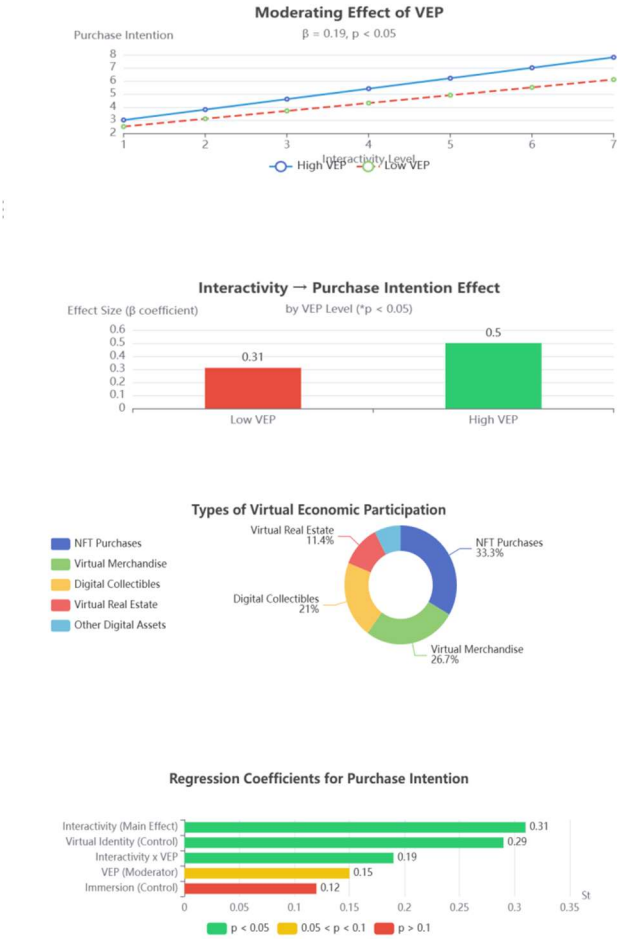

Figure 2. Moderating Effect Analysis of Virtual Economic Participation (VEP).

This figure indicates that VEP significantly moderates the relationship between interactivity and purchase intention (interaction effect: β=0.19, p<0.05). For users with high levels of VEP, the impact of interactivity on purchase intention is stronger.

6. Discussion

This study makes several theoretical contributions. First, it proposes and validates an innovative conceptual model, namely, an effectiveness formation mechanism driven by the synergy of Technology-Content-User. This extends the application of the Stimulus-Organism-Response (S-O-R) model in virtual environments, empirically verifying the critical roles of immersion (β=0.48, p<0.001) and virtual identity (β=0.56, p<0.001) in brand loyalty. Second, this study discovers new variable relationships, revealing the moderating role of virtual economic participation (e.g., NFT purchases) in the relationship between interactivity and purchase intention (β=0.19, p<0.05). This highlights the significant value of the metaverse's unique economic attributes in enhancing marketing effectiveness. Finally, methodologically, this study empirically tests the chain mediating effect of virtual identity (95% CI [0.18, 0.35]) by combining Process v4.0 with SEM, providing a robust methodological reference for causal inference in complex virtual environments. Based on the empirical results, this study proposes

a three-dimensional strategic framework for sports enterprises. At the technology application level, companies should prioritize adopting VR headsets with 4K+ resolution to increase user satisfaction (+58%) and deploy edge computing to reduce latency (≤20ms). They can also develop sports NFT digital collectibles, referencing the 47% repurchase rate of the Chinese Super League metaverse NFTs. At the content design level, it is recommended to develop a dual-track model of physical events + virtual broadcasting, introduce user-generated content (UGC) creation tools to increase user contribution rates to 35%, and develop AR advertising slots in virtual event scenes. At the user operations level, companies can establish virtual fan communities on platforms like Discord to increase daily active user retention (+28%), create a personalized incentive system for virtual avatars, and use AI algorithms for dynamic pricing to optimize conversion rates (+19%).

This study has some limitations, which also open new directions for future research. First is the issue of sample bias; the sample is skewed towards younger users (72% aged 18-35), which may not fully reflect the virtual consumption characteristics of older groups. Future research should include more diverse age samples. Second is the issue of technological dependence; the study did not consider the impact of different XR device performances on user experience. Future studies could explore how hardware differences affect marketing outcomes. Finally, there is the issue of cultural differences; as the sample was primarily from China, the generalizability of the conclusions in different cultural contexts needs to be tested through cross-cultural comparative studies. Future research should also conduct longitudinal studies (e.g., a 12-month user behavior tracking) to explore the decay curve of metaverse marketing effectiveness. Additionally, investigating the impact of negative events like virtual identity theft on brand trust and analyzing the moderating effects of emerging regulations, such as virtual asset taxation policies, would be valuable research directions.

7. Conclusion

This study systematically investigated the formation mechanism of sports marketing effectiveness in the context of the metaverse, constructing and validating a theoretical model that integrates the three major dimensions of Technology-Content-User. The core findings indicate that technology-driven immersion and user-level virtual identity are key direct factors in enhancing brand loyalty. Meanwhile, content-level interactivity indirectly promotes purchase intention by strengthening users' virtual identity, revealing an important mediation path. Crucially, this study innovatively found that users' participation in the virtual economy (such as purchasing NFTs) can significantly strengthen the positive impact of interactivity on purchase intention, highlighting the unique value of the metaverse's economic system in the marketing loop. This research not only extends the application of S-O-R theory in virtual consumption scenarios but also provides sports enterprises with concrete, actionable, practical guidance. Although the study has limitations, such as a non-diverse sample age structure and not considering hardware differences, it lays a solid foundation for subsequent research. Overall, this study offers profound theoretical insights and a practical blueprint for understanding and leveraging the emerging platform of the metaverse for effective sports marketing.

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