Pilot Study on the Effects of Gamification and Virtual Reality on the Shopping Experience

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- Keywords: Virtual Reality, e-Commerce, Gamification, Case Study, Consumer Behaviour.
- Abstract: E-commerce has embraced emerging technologies such as Virtual Reality (VR) and Augmented Reality (AR), which are transforming consumer interaction. In particular, VR enables the creation of immersive environments that simulate and enhance physical experiences, offering advantages such as gamification of the shopping process, thereby boosting user engagement and interaction. This pilot study addresses two main questions: how does the exploration of digitalized products in VR influence purchase intention? And, does a gamified experience with a specific product have an additional impact? In collaboration with a local business, an experiment involving 48 participants was designed. A portion of the store, its surroundings, and several products were digitalized using advanced techniques such as Neural Radiance Fields (NeRF) and Gaussian Splatting, achieving realistic models integrated into a virtual store accessible through Meta Quest 3 headsets. One specific product, a comic book, was gamified, allowing users to interact with its narrative, solve challenges, and be incentivized to purchase the product to discover the ending. Preliminary results, including a conversion rate of 41.9%, suggest that VR, especially when it incorporates gamification, can increase purchase intention and interest in local products, highlighting its potential in digital commerce.

1 INTRODUCTION

E-commerce field has experienced exponential growth in recent years, driven by the widespread adoption of digital technologies and changing consumer habits. This evolution has led retailers and businesses to explore new ways of interacting with consumers, aiming to replicate and, in many cases, surpass traditional shopping experiences (Castro-Schez et al., 2024). In this context, emerging technologies such as Virtual Reality (VR) and Augmented Reality (AR) have begun to play a crucial role in transforming e-commerce, offering tools to create immersive and personalized environments (Xi and Hamari, 2021).

VR has proven to be an effective medium for simulating and extending physical experiences, allowing users to interact with products and virtual environments in ways that were previously impossible. These immersive experiences not only expand the possibilities of e-commerce but also have the potential to significantly influence consumer behavior by enhancing product perception and fostering greater purchase intention (Khatri et al., 2022). One of the most promising applications of VR in e-commerce is gamification, which introduces playful elements into the shopping process, increasing user engagement and motivation (Azmi et al., 2021).

Although VR and gamification applications are gaining popularity, significant knowledge gaps remain. While various studies examine the impact of VR on purchase intention, most are conducted in controlled experimental settings where participants express their purchase intentions using fictitious money (van Herpen et al., 2016; Speicher et al., 2017; Gil-López et al., 2023). This limits the applicability of the results in real shopping contexts. Moreover, the combined impact of VR and gamification in authentic commercial environments, where purchase decisions are influenced by a combination of emotional, social, and contextual factors, has been scarcely explored (Donatiello et al., 2018).

This study addresses these limitations by conducting an experiment in a real-world setting: a three-day annual fair that brings together over 50 local businesses to showcase their products on the street. In the experiment, participants not only interacted with digitalized products in a VR environment but also had the opportunity to make actual purchases. This approach not only enhances the external validity of the results but also provides practical insights for local merchants interested in incorporating immersive

482

Grande, R., Cordero, D., Vallejo, D., González, C., Schez-Sobrino, S., Castro-Schez, J. J. and Albusac, J

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technologies as sales strategies (Christian Peukert and Weinhardt, 2019).

To explore the impact of VR and gamification on purchase intention, this study poses two main questions:

- 1. How does the exploration of digitalized products in VR influence purchase intention?
- 2. Does a gamified experience with a specific product have an additional impact?

In collaboration with a local business, a virtual environment replicating a section of the physical store was designed using advanced digitalization techniques such as Neural Radiance Fields (NeRF) and Gaussian Splatting to achieve a highly realistic visual representation. Additionally, the shopping experience for a specific product—a comic book—was gamified, allowing users to interact with its narrative and solve challenges related to its storyline. This design not only provided an immersive experience but also incentivized users to purchase the product to discover the story's outcome.

This study aims to evaluate how the combination of immersive technologies and gamification can enhance purchase intention and interest in local products within an e-commerce context. Furthermore, it seeks to highlight the potential of these technologies to support small businesses in their transition to the digital domain by offering innovative and accessible solutions that promote market competitiveness. In doing so, this work contributes to the existing literature on e-commerce and emerging technologies, providing valuable experimental data on the impact of VR and gamification in real-world shopping scenarios.

2 RELATED WORK

In this section, we will synthesise studies related to the use of VR in e-commerce, addressing proposed case studies and current work in the literature on gamification in e-commerce and VR.

Chen et al. (Chen et al., 2022) explore the role of Virtual Reality (VR) shopping environments in shaping consumers' impulse buying behavior, utilizing the Stimulus-Organism-Response (S-O-R) framework. The study investigates the effects of interactivity and vividness on telepresence, diagnosticity, and playfulness, which ultimately influence the urge to buy impulsively. The research employed a 2x2x2 factorial design experiment with 227 participants. The participants interacted with eight VR store scenarios featuring varying levels of interactivity, vividness, and product types. The experiment utilized a smartphone-based VR headset (Samsung Gear VR) to simulate immersive shopping experiences. The methodology focused on observing behavioral responses to the VR environment and collecting self-reported data through post-experiment surveys. The results demonstrate that both interactivity and vividness significantly enhance cognitive and affective responses, leading to a stronger tendency toward impulsive buying behavior. Further improvements in VR shopping systems are suggested to optimize user engagement and practical applications.

Donatiello et al. (Donatiello et al., 2018) examined the use of Virtual Reality (VR) and gamification in fashion e-commerce through "Fashion Island", a prototype virtual fitting room. The study involved 13 fashion students, evaluating usability and user experience via questionnaires. Results showed high satisfaction (average score: 3.93/5), with most participants appreciating the immersive and interactive elements. Minor issues like eye strain were noted, and one participant rejected the application due to discomfort. The authors highlight VR's potential to transform fashion e-commerce, though further refinement is needed to enhance user comfort and engagement.

Pizzi et al. (Pizzi et al., 2019) compare consumer behavior and perceptions between physical and VR-based grocery stores using a quasi-experimental, between-subjects design. The study investigates the influence of shopping orientations (utilitarian and hedonic) on store satisfaction and the moderating role of perceived assortment size. Participants interacted with identical shelf layouts of confectionery products in physical and virtual settings. In the VR condition, the store was recreated using 3D models with high visual fidelity. Data collection included time spent in the aisle, purchasing behaviors, and post-experience surveys measuring satisfaction and shopping orientations. Fictitious purchases were used in the study allowing for experimental control while mimicking realistic shopping behavior. Findings indicate that both utilitarian and hedonic shopping orientations significantly influence satisfaction in VR-based stores, consistent with physical store outcomes. However, satisfaction levels in VR were negatively impacted compared to physical stores, with larger perceived assortments mitigating this effect. The study highlights VR's potential as a retail research tool, demonstrating behavioral congruence between virtual and real environments.

Xi et al. (Xi et al., 2024) conducted a laboratory experiment to assess the acceptance of AR (augmented reality) and VR (virtual reality), in metaverse shopping. The study employed a 2x2 factorial design with 157 participants across four experimental conditions, including combinations of AR and VR. The research simulated a realistic shopping environment using a physical LP record store and its virtual counterparts developed with Unity and LiDAR scanning. The methodology involved participants receiving a 10€ virtual gift card to purchase second-hand LPs in different settings. These included physical stores with and without AR overlays and virtual stores with and without AR elements. The study measured perceived usefulness, enjoyment, ease of use, attitude, and intention to shop using psychometric questionnaires and the NASA-TLX scale for workload evaluation. Findings indicate that VR significantly enhances enjoyment, while AR improves product information accessibility but may reduce perceived ease of use. Despite these trade-offs, attitudes toward metaverse shopping remained positive, suggesting potential for these technologies to transform retail experiences. The study employed fictitious money for realistic decision-making and highlighted the importance of refining usability to ensure broader adoption.

Wölfel and Reinhardt (Wölfel and Reinhardt, 2019) examine the presentation of goods in virtual reality (VR) shopping environments, investigating whether consumer behavior in VR aligns with traditional retail settings. The study evaluates the impact of four parameters-product placement, quantity, size, and environment-on purchasing decisions. Using a VR setup with HTC Vive and Leap Motion, participants interacted with virtual milk and wine products displayed in various environments and configurations. The methodology involved 70 participants exploring 16 virtual scenarios where product characteristics such as placement on shelves, scarcity, size adjustments, and the surrounding environment were manipulated. Participants rated products based on attributes like ecological value, healthiness, and perceived quality. Results show that principles from physical retail, such as the preference for eye-level placement and the influence of scarcity, translate effectively to VR. The surrounding environment significantly impacted product evaluation, with matching environments enhancing positive perceptions.

Faganel et al (Faganel et al., 2024) explore the impact of gamification on Slovenian consumers' online shopping behaviors, focusing on how game elements influence various stages of the purchase decisionmaking process. VR gamification was not employed in their research. The study utilized a quantitative survey methodology, gathering data from 118 participants through a structured questionnaire. The results indicate that gamification has the greatest influence during the evaluation of alternatives, as participants compared benefits such as loyalty points and discounts across different online stores. However, gamification showed minimal impact on the post-purchase evaluation phase, contrary to initial hypotheses. The study also found that highly rated reviewers significantly influence purchasing decisions, whereas the majority of respondents were unwilling to spend more money for gamification-related benefits, such as earning points or badges.

The papers addressed showed that gamification in the context of VR e-commerce needs to be further explored, as well as engaging participants of case studies in contexts where real money is used to reallistically evaluate the impact of the VR experiences proposed in consumer behaviour.

3 BACKGROUND

This work is part of the VRZOCO research project (Castro-Schez et al., 2024), funded by the Spanish Ministry of Science and Innovation. Broadly speaking, the project aims to establish a synergy between commerce and other businesses in a town or city to strengthen its local economy. The following video provides a general overview of VRZOCO and showcases work carried out within the project, including a demonstration video related to the present paper: https://www.youtube.com/watch?v=T-CPiPvX54E.

A key innovation of the project lies in generating leisure/cultural plans linked to a pickup point for purchased products and the user's profile. The system optionally proposes the possibility of collecting purchases at a physical location. Around this point, it generates a plan that includes offers from nearby businesses and events that might interest the buyer based on their profile. For instance, tickets to museums, restaurant discounts, clothing store promotions, or offers to attend concerts, among others. This approach positions commerce as a starting point to boost the city's economy. The platform also enables multidirectional connections, whereby interest shown in any other business could lead to a purchase, further benefiting the specific commerce.

Another innovative aspect of the project is the inclusion of immersive technologies, such as VR, to enhance shopping experiences from home. Throughout the project's development, various techniques for product digitalization, such as NeRF and Gaussian Splatting, have been explored. These cost-effective techniques deliver high-quality model representations (Grande et al., 2024b), enabling small businesses with limited resources to access this functionality.

In a subsequent phase, the sales environment was virtualized, including fictional commercial spaces and

virtual recreations of existing stores. These spaces served as showcases for digitalized products. This phase particularly emphasized designing interaction mechanisms using hand-based exploration of products and adapting these mechanisms for individuals with physical limitations (Grande et al., 2024a).

Finally, in a later phase, interactive experiences were modeled to gamify the purchase of certain products, integrating game-like dynamics and mechanics to make the shopping experience more engaging and enjoyable. These experiences include, for example, allowing users to complete challenges or mini-games related to the products on display, earn virtual rewards that translate into discounts or promotions, or participate in rankings that encourage competitiveness among buyers. These strategies aim not only to increase user engagement but also to incentivize impulsive or planned purchases through emotional connection and perceived added value.

This study emerges from the need to measure, in a real-world scenario, the influence of virtual product exposure and participation in gamified shopping experiences on purchase intention and actual purchases. With studies of this nature, the goal is to validate the inclusion of immersive technologies as key tools in e-commerce.

4 CASE STUDY CONTEXT

The case study presented was conducted in collaboration with a business participating in a major sociocultural event in the city where our research group is based, the "Manchacómic!" ¹. This annual event, which attracts thousands of visitors, debuted 11 years ago and brings together leisure and cultural activities in the field of entertainment. Specifically, it features artistic exhibitions, workshops, lectures, and presentations related to books, video games, comics, movies, and other similar forms of entertainment.

At this event, various independent artists and businesses participate by offering products in themed *stands* related to "Manchacómic!". Among them is *Librería Serendipia*² (Serendipia bookshop), a wellestablished store specialized in books, comics, board games, and collectible items. Collaboration with this business facilitated the following:

1. Digitalizing a set of products from their physical store to be showcased in a VR application that allows interaction and inspection of these items.



Figure 1: Cover of the comic book "Pedro Girón".

- 2. Establishing contact with the authors of the comic book "Pedro Girón", which served as the basis for designing and developing the gamified VR experience. The comic's cover is shown in Fig. 1.
- 3. Coordinating with the "Manchacómic!" organizers to secure the space and equipment needed to conduct the experiment at the event venue. Fig. 3 shows our designated physical space and some of the volunteers involved in the case study.



Figure 2: One of the owners of *Librería Serendipia* trying out the VR application designed for the case study.

Having described the event's context in which the case study was conducted, we will now explain its specifics. For the case study, a VR application was developed for the Meta Quest 3 headset, featuring two scenes. The initial scene displayed a virtual store that

¹https://manchacomic.es

²https://www.libreriaserendipia.com/



Figure 3: Volunteers of different ages taking part of the case study.



Figure 4: Photographs taken of the interior of Librería Serendipia.

acted as a simplified replica of *Librería Serendipia*'s physical store. Fig. 2 shows one of the store's owners testing the virtual store and the gamified experience, which will be detailed later in this paper. Using the Unity game engine, this scene was developed to showcase a set of real products available in the physical store (see Fig. 4), which were digitalized in 3D using NeRF technology via the Luma AI mobile application³. These products were configured in Unity to allow user interaction, enabling free inspection.

First, users freely explored the virtual store, with instructions that they could enter the gamified experience at any time by interacting with a door located at the store's end. This door acted as a loading screen for the next scene, which featured a gamified shopping experience centered on the comic book "Pedro Girón." To leverage VR's immersive capabilities, this experience was set in a virtual recreation of "Calatrava la Nueva Castle"⁴. This castle, besides being a cultural landmark of the authors' region, is part of the comic's setting and narrative. In this scene, users explored the virtual environment to locate four puzzle pieces that formed the comic's cover. As pieces were found, the story's protagonist, modeled in 3D, narrated brief excerpts from the comic's opening scenes. The gamified experience concluded when the user

completed the puzzle.

After testing the VR application, volunteers completed a 15-question survey regarding the use of VR as a shopping tool and their user experience with the gamified elements presented. The survey explicitly asked about purchase intention in VR to evaluate the influence of this technology and the potential of offering gamified experiences on user purchase intention. Volunteers were then given two tickets if they wished to make a purchase at the *Librería Serendipia* stand: one to identify if they purchased a product showcased in the virtual store and another to identify if they purchased the comic.

Finally, a count was conducted of individuals who purchased either the comic or one of the products displayed in the virtual store. This was made possible by distributing tickets to volunteers, which allowed identification when purchases were made at the *Librería Serendipia* stand during the event. This count enabled the calculation of the Conversion Rate (CR) for the experience offered and comparison with conversion rates reported in the literature.

5 PRODUCT DIGITALIZATION

The scanning process to digitalize the set of products from *Librería Serendipia* showcased in the virtual store was conducted using Luma AI, a free tech-

³https://lumalabs.ai/interactive-scenes

⁴https://en.wikipedia.org/wiki/Calatrava_la_Nueva



Figure 5: Virtual shop environment with 3D scanned Serendipia's products.

nology for iOS mobile devices. This NeRF-based technology is capable of providing high-quality 3D models without compromising the performance of the Meta Quest 3 (Grande et al., 2024b). This aspect is crucial, as the case study aimed to provide a standalone experience, meaning that the Meta Quest did not need to be connected to a computer (MSI Vector GP66, featuring an i7-12700H, 32GB RAM, and an Nvidia GeForce RTX 3060 6GB VRAM GPU) to use the PC GPU's computing power. This approach ensured a consistent frame rate close to 72 FPS. Following recommendations and best practices (Grande et al., 2024b), products from *Librería Serendipia* were digitalized. Two photographs of sections of their physical store can be observed in Fig. 4.

SCIENCE AND TR

6 INTERACTIVE GAMIFIED EXPERIENCE

As previously mentioned, an interactive experience was developed for the "Manchacomic!" event. In this case, the comic Pedro Girón" from the "Calatrava" saga was chosen for its development. The project involved asynchronous collaboration with the comic's artist, who has expertise in 3D modeling. Before detailing the development of the gamified experience for the comic, Fig. 5 shows the virtual store replica of *Librería Serendipia*, where several of its digitalized products are displayed. As observed, the fully stocked shelves shown in Fig. 4 are significantly simplified to avoid overwhelming the user visually and to focus their attention on the showcased products.

The development process for the experience began once the 3D models were available for both the immersive space (a replica of an interior section of the Calatrava la Nueva castle) and the protagonist of the story, Pedro Girón. This 3D space was created by the co-author of the comic, using a different standard from the one typically followed for creating video game maps. As a result, the model lacked a defined floor, meaning that the Meta Quest 3 SDK would not recognize any surface as navigable. Therefore, the first step was to modify the entire interior space of the castle to make it navigable. This required re-simulating the entire structure of floors and areas intended to be accessible in VR and overlaying them with the existing model so that they could be marked as accessible zones in the development engine (see Fig. 6).

Once this was completed, the next step involved the modeled character, for which a 3D skeleton had to be created to enable "realistic" animations. This was achieved by creating a skeleton with anthropomorphic proportions and joints, to which various nodes of the already-created character mesh were assigned. After the skeleton was assigned to the character and numerous manual animation tests were conducted, it was decided to use pre-made animations that fit the requirements for the immersive experience. With both the protagonist and the space ready, development in Unity, the chosen engine for this experience, could commence. The 3D model of the protagonist with its skeleton can be observed in Fig. 7.

The chosen gamification for the experience was a simple puzzle involving the search for pieces. The comic was divided into four equal parts scattered throughout the castle, and the player needed to find them to uncover the protagonist's past. A short script was developed for this purpose, in which the protagonist appeared, asking for help because he had lost his memory and was trapped in the castle. The way to help him was by retrieving the comic pieces. Each time a piece was found, the knight would recount part of his story, which would be interrupted upon finding the last piece of the puzzle, encouraging the player to purchase the comic to learn the rest.

In terms of development, the Meta SDK in Unity



Figure 6: Calatrava's castle 3D space before and after adding the navigable surfaces.



Figure 7: Pedro Girón, comic's main character, manually rigged.

was used, enabling the use of virtual hands and all related movements. The environment was fully navigable with a teleportation system included in the Meta development kit. This system, combined with the previously implemented virtual hand-grabbing mechanics, facilitated the creation of the puzzle. The final design required players to search the castle for comic pieces and deliver them to the table indicated by the knight. Each time a piece was brought to the table, the knight would narrate a new line of the script; upon delivering the last piece, the knight would give his final speech, including instructions on where to purchase the comic (see Fig. 9).

Another critical decision was how to make the transition from the virtual store to a medieval-themed interactive experience feel natural. To avoid a jarring shift, such as a simple black screen cut, a "magical" door was added inside the store, as shown in Fig. 8. This door would open as the player approached with the headset, signaling access to a different activity. Additionally, a loading screen was included between scenes to clearly indicate the transition into the activity centered on the comic "Pedro Girón."



Figure 8: Magic door located in the VR shop, giving acces to the interactive experience.



Figure 9: Screenshot taken of main character at the beggining of the gamified experience scene.

7 RESULTS

The experiment was conducted in a single 4-hour session. During the activity, 48 individuals (33 male, 14 female, and 1 person who did not identify with either gender) of a broad age range participated, as detailed in Table 3. These participants were not specifically invited and had no prior knowledge of the VR-ZOCO project or the experiment. The only way they could learn about the activity was by passing through the event space or consulting its program. Additionally, it is worth noting that only 5 of the 48 participants were familiar with the comic Pedro Girón" before being introduced to the gamified VR experience. Spatio-temporal data were recorded for each user testing the gamified experience, following the framework for data logging in VR environments described in (Grande et al., 2024c). Fig. 10 shows the distribution of time spent, in seconds, by the volunteers in the gamified experience. Participants spent an average of 258.69 seconds in this experience, with a median of 218.34 seconds, a first quartile of 178.21 seconds, and a third quartile of 317.18 seconds. These temporal data reflect only the time spent in the gamified comic experience, excluding time spent in the virtual store.



Figure 10: Boxplot of time spent by volunteers in the gamified exprience.

Moreover, Table 1 displays the distribution of the percentage of the scene explored by users, derived from spatial data on user positions within the Unity scene. These data were exclusively collected during the gamified experience scene. The coverage percentage was calculated as the ratio between the volumes of the scene and the bounding box of user movement:

Coverage (%) =
$$\left(\frac{\max(HMD_x) - \min(HMD_x)}{\max(x) - \min(x)}\right) \times \left(\frac{\max(HMD_y) - \min(HMD_y)}{\max(y) - \min(y)}\right) \times \left(\frac{\max(HMD_z) - \min(HMD_z)}{\max(z) - \min(z)}\right) \times 100$$
 (1)

where HMD_i represents the user head position for coordinate *i*. This metric helps identify which areas were explored by users, providing insights for designing refined virtual store layouts or gamified experiences that focus user attention on frequently visited areas or regions that attracted the majority of participants. On average, a coverage of 72.88% was achieved for the total scene space explored by each participant. This indicator highlights a general interest in the gamified experience, demonstrating user proactivity in exploring the environment to complete the proposed objective.

Table 1: Coverage performed over the gamified experience scene

| Statistic | Value |
|---------------------------|-------|
| Mean Coverage (%) | 72.88 |
| Median Coverage (%) | 79.02 |
| First Quartile (Q1) | 65.44 |
| Third Quartile (Q3) | 93.79 |
| Interquartile Range (IQR) | 28.34 |

7.1 Survey Results

After using the described VR experience, volunteers responded to a 15-question survey, as shown in Table 2. The survey included 14 questions on a Likert scale from 1 to 5, where 1 represents the lowest or most negative score, and 5 the highest or most positive. The questions can be categorized based on the aspects they aim to address: i) experience with VR and its integration with e-commerce (Q1 to Q4 and Q7), ii) user experience and comfort (Q5, Q6, Q8, Q9, Q11, and Q12), and iii) purchase intention (Q10, Q13, Q14, and Q15). Question 7 is a binary question to determine participants' preferences, after testing the VR experience, for examining products on a website or using VR. The results for this question are shown in Fig. 12, indicating a preference for examining products using VR whenever possible. When analyzing Question 4 in Table 2, which asks whether participants prefer examining products viewed in VR on the commerce's web portal or through VR, both the mode and median indicate a generalized preference for VR, as also reflected in the circular chart in Fig. 12.

Moreover, Fig. 11 displays the distribution and variance of responses in the form of boxplots. Analyzing these data alongside those provided in Table 2, a predominantly positive evaluation is observed, as evidenced by the high concentration of responses in the upper values of the Likert scale for key questions, such as interest in using VR for shopping (Q2, median (Me) = 4.0, mean (M) = 4.16) and perception of the technology as innovative (Q3, Me = 5.0, M = 4.43). The low dispersion in these questions, represented by compact interquartile ranges and the absence of significant outliers, suggests consensus among participants regarding the innovative potential of VR.

One of the most notable aspects is the system's ability to provide an immersive experience. The question on the sense of immersion (Q6) showed a high median (5.0) and a mean of 4.43, with a narrow interquartile range indicating uniformity in responses. This result is complemented by positive evaluations of interaction comfort and naturalness (Q5, Me = 4.0, M = 4.20), a critical factor for ensuring technologi-

| ID | Question | Mean | Std. Dev. | Mode | Median |
|----|--|-------|-----------|------|--------|
| 1 | What experience do you have with virtual reality devices? | 2.58 | 1.47 | 1.0 | 2.0 |
| | (1- None, 2- Little, 3- Occasional, 4- Frequent, 5- A lot) | 2.30 | 1.47 | 1.0 | 2.0 |
| 2 | How interested are you in Virtual Reality and being able to shop using this technology? | 4.16 | 0.85 | 5.0 | 4.0 |
| | (1- None, 2- Little, 3- Neutral, 4- Quite a bit, 5- A lot) | 4.10 | 0.85 | 5.0 | 4.0 |
| 3 | How novel do you find the option of shopping on an e-commerce portal with virtual reality? | 1 / 3 | 0.68 | 5.0 | 5.0 |
| | (1- Not novel, 2- Not very novel, 3- Neither novel nor not novel, 4- Novel, 5- Very novel) | т.т.5 | 0.00 | 5.0 | 5.0 |
| 4 | Do you prefer exploring store products in VR or via their web portal? | 3 74 | 1.26 | 5.0 | 4.0 |
| | (1- Much more on the web, 3- I do not prefer one over the other, 5- Much more in VR) | 5.74 | 1.20 | 5.0 | 4.0 |
| 5 | Did you find the interactions natural and comfortable? (including teleportation) | 4 20 | 0.79 | 40 | 4.0 |
| | (1- Very little, 2- Little, 3- Neutral, 4- Quite a bit, 5- A lot) | 4.20 | 0.79 | 4.0 | 4.0 |
| 6 | Did you feel immersed in the VR application? | 4 4 3 | 0.85 | 5.0 | 5.0 |
| | (1- Very little, 2- Little, 3- Neutral, 4- Quite a bit, 5- A lot) | 5 | 0.05 | 5.0 | 5.0 |
| 7 | Do you prefer to examine products on the web or in VR? | - | - | - | - |
| 8 | Feeling of dizziness or general discomfort | 1.52 | 1.05 | 10 | 1.0 |
| | (1- None, 2- Little, 3- Neutral, 4- Quite a bit, 5- A lot) | 1.52 | 1.05 | 1.0 | 1.0 |
| 9 | How positive was your experience exploring the store with virtual reality? | 4.46 | 0.68 | 5.0 | 5.0 |
| | (1- Very negative, 2- Negative, 3- Neutral, 4- Positive, 5- Very positive) | | | | |
| 10 | Would your purchase intention change when seeing products in VR instead of on a web page? | 3.93 | 1.11 | 5.0 | 4.0 |
| | (1- None, 5- A lot) | 5.75 | 1.11 | 5.0 | 4.0 |
| 11 | Would you use such stores again to explore products you're interested in buying? | 4 22 | 0.95 | 5.0 | 5.0 |
| 11 | (1- None, 5- A lot) | 7.22 | 0.75 | 5.0 | 5.0 |
| 12 | Does exploring products through play as seen in the comic motivate you? | 4 4 4 | 0.77 | 5.0 | 5.0 |
| 12 | (1- None, 5- A lot) | 4.44 | 0.77 | 5.0 | 5.0 |
| 13 | Did you find the comic's VR experience entertaining? | 4.68 | 0.59 | 5.0 | 5.0 |
| 15 | (1- None, 5- A lot) | 4.00 | 0.57 | 5.0 | 5.0 |
| 14 | Would you be interested in learning more about the comic's story? | 4.21 | 1 21 0.98 | 50 | 50 |
| 14 | (1- None, 5- A lot) | 7.21 | 0.76 | 5.0 | 5.0 |
| 15 | Do you intend to buy the Calatrava comic? | 2.22 | 1.49 | 5.0 | 3.0 |
| 15 | (1 - None - 5 - A - lot) | 5.55 | 1.77 | 5.0 | 5.0 |

Table 2: Survey's questions as well as descriptive statistics of answers per question



Figure 11: Boxplots representing the answers given by each volunteer.

cal acceptance. However, these questions include outliers, reflecting that some participants found the interactions less intuitive, highlighting the need to refine interface design to accommodate users with varying levels of technological familiarity. In contrast, participants' prior experience with VR devices (Q1) shows a median of 2.0 and a mean of 2.58, indicating that most users had little or no prior experience. This dispersion, combined with a broad interquartile range, reveals a heterogeneous sample in

| Statistic | Age |
|--------------------|-------|
| count | 48.0 |
| mean | 23.67 |
| standard deviation | 13.62 |
| minimum | 8.0 |
| 25% | 12.0 |
| 50% | 21.0 |
| 75% | 29.5 |
| maximum | 55.0 |

Table 3: Age statistics of the case study's volunteers

Do you prefer examining products on the Web or in VR?



tem generated interest, direct conversion to purchases may depend on additional factors, such as personal preferences and emotional connection to the product. Nonetheless, the following section will present sales data obtained from users who tested the gamified experience in this case study.

7.2 Purchases

Breakdown of Case Study Purchases



Figure 12: Preference for examining products on the web or in VR by volunteers.

terms of prior exposure to this technology. Consequently, alongside the diverse ages of volunteers, the time spent on the gamified comic experience varied, influenced by participants' proficiency with the Meta Quest 3 based on their prior experience and age. This variability aids in interpreting study results within a predominantly VR-inexperienced group. A generally positive evaluation of the experience could indicate reduced resistance and skepticism toward using VR in gamified shopping contexts, contrasting with resistance observed in other sectors (Cham et al., 2023).

A key technical aspect is the low incidence of nausea or discomfort during system use (Q8, Me = 1.0, M = 1.52). The concentration of responses at the lower end of the scale, alongside the absence of outliers, confirms a robust design and a smooth experience. Given the volunteers' limited VR experience, a poorly designed experience would have resulted in generalized discomfort. This finding aligns with positive evaluations of VR's impact on purchase intention (Q10, Me = 4.0, M = 3.93) and motivation derived from gamified elements (Q12, Me = 5.0, M = 4.44).

However, as observed, there is greater dispersion in questions related to exploration preferences (Q4) and the intention to purchase the comic (Q15), with medians of 4.0 and 3.0, respectively. In particular, Q15 shows a relatively low mean (3.33) and a broad interquartile range, suggesting that while the sys-

Figure 13: Purchases made by volunteers after they participated in the case study.

At the end of the experience, the staff present at the Librería Serendipia stand provided us with the tickets from participants who made a purchase after engaging in the case study. The comic's price was $\in 20$, which is relatively high compared to the typical price of a comic with fewer pages, usually around $\in 5$. This pricing could have influenced the lower number of sales. Nevertheless, the data obtained reveals significant insights into consumer behavior and the effectiveness of the gamified approach. Fig. 13 illustrates the purchase behavior of 43 participants who interacted with the VR application, which included exposure to both a gamified comic and a virtual store showcasing various products. It is important to note that 5 of the 48 participants informed us they already owned the comic and were not interested in purchasing anything at the Manchacómic!" event before participating in the interactive experience. Therefore, the data focuses on the remaining 43 participants who did not already own the comic. Among these participants, 41.9% made a purchase, with 23.3% buying products displayed in the VR store and 18.6% acquiring the "Pedro Girón" comic central to the gamified experience. Conversely, 58.1% of participants did not make any purchases. The overall conversion rate of 41.9% significantly exceeds the typical e-commerce conversion benchmark of 2-5% (Zumstein and Schäfer, 2020; Purnomo, 2023; Fatta and Lu, 2018; Li et al., 2022), highlighting the substantial impact of the gamified experience on purchasing decisions.

Regarding the results of Q5, 16 participants rated their purchase intention with a 5, and 6 participants with a 4, meaning 22 individuals expressed a higherthan-average purchase intention. With 8 comic sales, this implies that 36.40% of those who explicitly expressed greater interest in purchasing the comic followed through, demonstrating the significant conversion rate among this group.



Figure 14: Sales of "Pedro Girón" over the three days of "Manchacomic!" event.

Sales patterns over three days were provided by Librería Serendipia. As depicted in Fig. 14, further emphasize the effectiveness of this approach. On Friday, eight comics were sold, while sales peaked on Saturday with 29 comics purchased, of which 27.6% were sold to volunteers that participated in our case study. Sunday recorded a smaller but still significant number of sales, with 10 comics purchased. In total, 47 comics were sold over the event, including additional sales to non-participants. It is interesting to note that activities regarding the comic were also hold on Friday (author's book signing), on Saturday's evening and Sunday (author's talk), which might had influence on the sales made those days. However, 8 of the sales made in Saturday were directly influenced by the gamified experience because those were made during the morning, and the author's talk was held on Saturday's evening. The sharp increase in sales on Saturday, accounting for 61.7% of total comic purchases, highlights the effectiveness of combining gamified experiences and other activities in attracting and retaining customer interest.

The gamified VR experience proved highly effective in driving consumer engagement and purchase behavior. Notably, the "Pedro Girón" comic, which was directly tied to the VR gamified application, contributed to an 18.6% conversion rate. This outcome underscores the importance of product relevance and experiential design in e-commerce strategies. The immersive and interactive nature of the VR environment, coupled with gamification, appears to have significantly enhanced the participants' willingness to engage with and purchase the featured products.

8 CONCLUSIONS AND FUTURE WORK

In this paper, we have described how gamification proposals can be beneficial in immersive shopping experiences using VR. Specifically, we have presented the background of the VRZOCO case study, an ecommerce platform aimed at supporting small businesses through VR and AI. Gamified experiences in VR can expand the reach of this technology in e-commerce while offering innovative proposals to boost sales, conduct marketing campaigns, or implement promotions. The results obtained in the case study reinforce this, achieving a 41.9% conversion rate, with 18.6% corresponding to the €20 comic sales and 23.3% to products displayed in the virtual store. Furthermore, the comic sales impact during the event was notable, with Saturday morning sales equaling the total sales on Friday. These conversion rates exceed typical benchmarks for other marketing strategies or promotions in e-commerce.

Moreover, the mean coverage rate of 72.88% demonstrates the interest of the users in the gamified experience proposed, as the Unity scene was greatly explored to complete the objective proposed. The success of this approach lies in its ability to blend immersion, interactivity, and targeted promotions to influence consumer behavior effectively. These findings highlight the transformative potential of gamified VR environments in e-commerce, particularly for products that allow to develop interesting gamified experiences. Future studies should focus on evaluating the long-term retention and satisfaction levels of consumers who engage with such experiences, as well as exploring their applicability across different product categories and market segments.

As future work, we are exploring the impact of other gamification systems within immersive VR shopping experiences, such as point accumulation. Additionally, we intend to investigate the influence of theming virtual stores by type, for example, toy stores, and by season, such as Christmas. Gamification in these contexts could increase the acceptance of VR for shopping purposes.

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REFERENCES

- Azmi, L. F., Ahmad, N., and Iahad, N. A. (2021). Gamification elements in e-commerce – a review. In 2021 International Congress of Advanced Technology and Engineering (ICOTEN), pages 1–5.
- Castro-Schez, J. J., Grande, R., Herrera, V., Schez-Sobrino, S., Vallejo, D., and Albusac, J. (2024). E-marketplace state of the art and trends: Vr-zoco—an architectural proposal for the future. *Applied System Innovation*, 7(5).
- Cham, T.-H., Tan, G., Aw, E., Ooi, K.-B., Jee, T.-W., and Pek, C.-K. (2023). Virtual reality in tourism: adoption scepticism and resistance. *Tourism Review*, 79.
- Chen, J., Ha, Q. A., and Vu, M. (2022). The influences of virtual reality shopping characteristics on consumers' impulse buying behavior. *International Journal of Human-Computer Interaction*, 39.
- Christian Peukert, Jella Pfeiffer, M. M. T. P. and Weinhardt, C. (2019). Shopping in virtual reality stores: The influence of immersion on system adoption. *Journal of Management Information Systems*, 36(3):755–788.
- Donatiello, L., Morotti, E., Marfia, G., and Di Vaio, S. (2018). Exploiting immersive virtual reality for fashion gamification. In 2018 IEEE 29th Annual International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC), pages 17–21.
- Faganel, A., Pačarić, F., and Rižnar, I. (2024). The impact of gamification on slovenian consumers' online shopping. *Administrative Sciences*, 14(5).
- Fatta, D. D. and Lu, D. D. (2018). Conversion rate determinants in e-commerce websites. what about moderation effects? *International Journal of Electronic Marketing and Retailing*, 9:366–377.
- Gil-López, C., Guixeres, J., Moghaddasi, M., Khatri, J., Marín-Morales, J., and Alcañiz Raya, M. (2023). Recognizing shopper demographics from behavioral responses in a virtual reality store. *Virtual Reality*, 27.
- Grande, R., Albusac, J., Sánchez-Sobrino, S., Vallejo, D., Jesús Castro-Schez, J., and González, C. (2024a). Exploring interaction mechanisms and perceived real-

ism in different virtual reality shopping setups. In *Proceedings of the 26th International Conference on Enterprise Information Systems - Volume 2: ICEIS*, pages 505–512. INSTICC, SciTePress.

- Grande, R., Albusac, J., Vallejo, D., Glez-Morcillo, C., and Castro-Schez, J. J. (2024b). Performance evaluation and optimization of 3d models from low-cost 3d scanning technologies for virtual reality and metaverse ecommerce. *Applied Sciences*, 14(14).
- Grande, R., Albusac, J. A., Vallejo, D., González-Morcillo, C., Sánchez-Sobrino, S., and Castro-Schez, J. J. (2024c). Virtual reality shopping-insights: A datadriven framework to assist the design and development of virtual reality shopping environments. *SoftwareX*, 27.
- Khatri, J., Marín-Morales, J., Moghaddasi, M., Guixeres, J., Chicchi Giglioli, I., and Alcañiz Raya, M. (2022). Recognizing personality traits using consumer behavior patterns in a virtual retail store. *Frontiers in Psychology*, 13:752073.
- Li, J., Wang, X.-L., and Wang, Y. (2022). The effect of conversion rate on product sales from the perspective of aisas model: An empirical study based on the data of the amazon merchants. *Proceedings of the International Conference on Big Data Economy and Digital Management.*
- Pizzi, G., Scarpi, D., Pichierri, M., and Vannucci, V. (2019). Virtual reality, real reactions?: Comparing consumers' perceptions and shopping orientation across physical and virtual-reality retail stores. *Computers in Human Behavior*, 96:1–12.
- Purnomo, Y. J. (2023). Digital marketing strategy to increase sales conversion on e-commerce platforms. *Journal of Contemporary Administration and Management (ADMAN).*
- Speicher, M., Cucerca, S., and Krüger, A. (2017). Vrshop: A mobile interactive virtual reality shopping environment combining the benefits of on- and offline shopping. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.*, 1(3).
- van Herpen, E., van den Broek, E., van Trijp, H. C., and Yu, T. (2016). Can a virtual supermarket bring realism into the lab? comparing shopping behavior using virtual and pictorial store representations to behavior in a physical store. *Appetite*, 107:196–207.
- Wölfel, M. and Reinhardt, A. (2019). Immersive shopping - presentation of goods in virtual reality.
- Xi, N., Chen, J., Gama, F., Korkeila, H., and Hamari, J. (2024). Acceptance of the metaverse: a laboratory experiment on augmented and virtual reality shopping. *Internet Research*, 34:82–117.
- Xi, N. and Hamari, J. (2021). Shopping in virtual reality: A literature review and future agenda. *Journal of Business Research*, 134:37–58.
- Zumstein, D. and Schäfer, W. (2020). Success factors of ecommerce - drivers of the conversion rate and basket value.