AN IMPACT OF MULTI SENSORY VIRTUAL REALITY ON DEUTSCHES MUSEUM VISITORS PLEASANT EXPERIENCE TOWARDS REUSE AND PURCHASE INTENTION

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THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

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AN IMPACT OF MULTI SENSORY VIRTUAL REALITY ON DEUTSCHES MUSEUM VISITORS PLEASANT EXPERIENCE TOWARDS REUSE AND PURCHASE INTENTION

ABSTRACT

Academic literature highlights the gratifications of using virtual reality (VR) in tourism but does not provide insights into fulfilling those gratifications after using multi-sensory VR. Several research models are used in the literature to study gratifications, but the literature is unable to highlight the best suitable model to measure gratifications. Therefore, this research was conducted in a multi-sensory VRlab of Deutsches Museum, Munich, to address the existing gaps in the literature. The first research objective to understand visitors' needs for using multi-sensory VR was addressed through 11 face-to-face interviews. The research model and questionnaires for this research were designed based on the emerging themes from interviews. The gratification discrepancies approach (GO-GS) of uses and gratifications theory was the primary theory applied in this research. Several nuanced gratifications were adopted, such as entertainment, education, novelty and telepresence. The data were collected two times from n = 227 respondents – before and after using VR through a cross-sectional survey design. SPSS was used for the initial data screening, and PLS-SEM was used to conduct structural equation modelling. Second research objective concludes that education, telepresence, and novelty gratifications were over-fulfilled by VR (GO>GS), but the entertainment was under-fulfilled (GO<GS). Visitors were expecting more entertainment, but VR content at Deutsches Museum could not meet their expectations. Third objective was to study the educational impact of VR at tourism destinations, which shows a drastic change in pre and post usage familiarity, concluding that the visitors preferred to get education from VR, and virtual reality is a good tool to provide education during tourism activities. Fourth objective was to provide one best suitable

model to measure media consumption consequences. Therefore, seven different models were compared in quantitative analysis 1, for example, (i) gratifications sought model ∑(GS), (ii) gratifications obtained model ∑(GO), (iii) simplified discrepancy model ∑(GO - GS), (iv) discrepancy weighted by users' personal importance model ∑ *j*(GO - GS), (v) transactional model of model iii ∑(GS+GO), (vi) transactional model of model iv ∑ *j*(GS+GO) and (vii) modified gratifications obtained model ∑ *j*(GO). The result of analysis 1 concluded that the gratifications obtained model (ii) is a suitable model to influence the pleasantness of experience. The suitability was studied according to the best coefficient of determination (R^2) and lowest error terms of asymptotical efficiency and consistency criteria. Fifth objective was to further investigate the role of gratifications obtained on reuse and purchase intentions through the mediating role of the pleasantness of experience (analysis 2). The model's predictive ability was tested with the help of R^2, the blindfolding-based measure Q^2 and PLS-predict. The visitors reported a pleasant experience through entertainment, education, and telepresence, which led them to reuse VR at tourism destinations and purchase it. In contrast, the novel experience of VR had no impact on reusing and purchasing intentions. Overall, this research concludes that the simple gratifications obtained model is a suitable model to study media consumption consequences, and entertainment, education, and telepresence are the driving factors behind a pleasant experience with VR. Several managerial recommendations are also presented at the end of the thesis.

Keywords

Gratifications sought & obtained (GO-GS), uses and gratifications theory (U&G), multi-sensory virtual reality (VR), tourism, museum.

IMPAK REALITI MAYA MULTI DERIA TERHADAP PENGALAMAN MENYENANGKAN PELAWAT MUZIUM DEUTSCHES TERHADAP NIAT GUNA SEMULA DAN PEMBELIAN

ABSTRAK

Sorotan literatur membincangkan tentang kepuasan penggunaan reality maya (VR) di dalam industry pelancongan tetapi tidak membincangkan perspektif dalam memenuhi kepuasan VR selepas menggunakan VR pelbagai deria. Beberapa model kajian telah dibentuk di dalam literatur untuk mengkaji kepuasan, namun belum terdapat model yang sesuai untuk mengukur kepuasa. Justeru, kajian ini telah dijalankan di dalam makmal pelbagai deria (VR) di Muzium Deutsches, Munich, bagi memenuhi jurang yang terdapat di dalam literatur. Objektif penyelidikan pertama untuk memahami keperluan pelawat untuk menggunakan VR berbilang deria telah ditangani melalui 11 temu bual bersemuka. Model kajian dan soal selidik untuk kajian ini telah dirangka berdasarkan tema-tema yang didapati daripada temubual yang telah dijalankan. Kaedah perbezaan kepuasan (GO-GS) daripada teori kegunaan dan kepuasan adalah teori utama yang telah digunakan dalam kajian ini. Beberapa spektrum kepuasa telah digunakan seperti hiburan, pendidikan, kebaharuan, dan keberadaan maya. Data bagi kajian ini telah dikutip dalam dua jangka masa berbeza sebanyak n=227 responden – sebelum dan selepas menggunakan VR melalui reka bentuk kajian keratan rentas. SPSS telah digunakan pada fasa awal saringan data, dan PLS-SEM telah digunakan untuk pemodelan persamaan struktur. Objektif penyelidikan kedua menyimpulkan bahawa pendidikan, telepresence dan kepuasan kebaharuan telah terlebih dipenuhi oleh VR (GO>GS), tetapi hiburan itu kurang dipenuhi (GO<GS). Pelawat mengharapakn lebih hiburan, tetapi VR di Muzium Deutsches tidak dapat memenuhi jangkaan mereka. Objektif ketiga adalah untuk mengkaji kesan pendidikan VR di destinasi pelancongan, yang menunjukkan perubahan drastik dalam kebiasaan sebelum dan selepas penggunaan, menyimpulkan bahawa pelawat lebih suka mendapatkan pendidikan

daripada VR, dan realiti maya ialah alat yang baik untuk menyediakan pendidikan semasa aktiviti pelancongan. Objektif keempat adalah untuk menyediakan satu model terbaik yang sesuai untuk mengukur akibat penggunaan media. Beberapa model telah dibandingkan dalam analisa kuantitatif 1, seperti contoh (i) model kepuasan dicari ∑(GS), (ii) model kepuasan yang diperolehi ∑(GO), (iii) model percanggahan dipermudahkan ∑(GO - GS), (iv) model percanggahan yang ditimbang oleh kepentingan $\sum j$(GO - GS), (v) model transaksional model iii ∑(GS+GO), (vi) model transaksional model iv $\sum j$(GS+GO) dan (vii) model kepuasan yang diubah suai diperolehi $\sum j$(GO). Dapatan daripada analisa 1 mendapati model kepuasan diperolehi (ii) adalah model yang sesuai untuk mempengaruhi keseronokan pengalaman. Kesesuaian telah dikaji mengikut pekali penentuan yang terbaik (R^2) dan terma ralat rendah bagi kecekapan asimptotik dan kriteria konsisten. Objektif kelima adalah untuk menyiasat lebih lanjut peranan kepuasan yang diperolehi ke atas niat penggunaan semula dan pembelian melalui peranan pengantara keseronokan pengalaman (analisis 2). Keupayaan ramalan model di uji dengan bantuan R^2, ukuran berdasarkan penutup mata dan PLS-menjangkakan. Pengujung melaporkan keseronokan pengalaman melalui hiburan, pendidikan, dan keberadaan maya, yang memangkin merekan untuk menggunakan VR dalam memilih destinasi pelancongan dan membelinya. Berbeza dengan kebaharuan VR yang tidak mempunyai impak dalan penggunaan berulang dan niat pembelian. Beberapa cadangan pentadbiran dibentangkan pada penghujung tesis ini.

Kata kunci

Kepuasan yang diperolehi dan dicari (GO-GS), teori penggunaan dan kepuasan (U&G), realiti maya pelbagai deria (VR), pelancongan, muzium.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS AND ABBREVIATIONS

ADO	- Antecedents, decisions and outcome
AR	- Augmented reality
AVE	- Average variance extracted
B	- Number of Bootstrap sample
BCa	- Bias-corrected and accelerated
BCI LL	- Bootstrap confidence interval lower limit
BCI UL	- bootstrap confidence interval upper limit
BI	- Behavioural intention
CBSEM	- Co-variance based structural equation modelling
CFA	- Confirmatory factor analysis
CMV	- Common Method Variance
CR	- Composite reliability
df	- Degree of freedom
DV	- Dependent variable
e	- Evaluation
EDU	- Education
ENT	- Entertainment
GS	- Gratifications sought
GO	- Gratifications obtained
HMD	- Head mounted displays
HTMT	- Heterotrait-monotrait criteria
ICTs	- Information and communication technologies
IV	- Independent variable
LM	- Linear regression model

M - Mean

MAE - Mean absolute error

n - Total numbers

NOV - Novelty

PLExp - Pleasantness of experience

PLS - Partial least square

PLS-SEM - Partial least square structural equation model

PurInt - Purchase intention

Q^2 - Blindfolding-based measure

R^2 - Coefficient determinant

ReuseInt - Reuse intention

RMSE - Root mean square error

SD - Standard deviation

SE - Standard error

SEM - Structural equation modelling / structural equation model

Sig. - Significance level

SPSS - Statistical package for social science

SCI - Sciences citation index

SSCI - Social science citation index

SLR - Systematic literature review

TCCM - Theory, construct, characteristics and methodology

TP - Telepresence

U&G - Uses and gratifications

VIF - Variance inflation factor values

VLE - Virtual learning environments

VR - Virtual reality

WWW - World Wide Web

6DoF - Six degrees of freedom

LIST OF APPENDICES

LIST OF PUBLICATIONS AND PAPERS PRESENTED

CHAPTER 1: INTRODUCTION

"Virtual reality is like dreaming with your eyes open"-Brennan Spiegel

1.1 Background of the study

Technological advancement plays an essential role in communication, entertainment, and marketing processes (Pae & Hyun, 2002; Wolters, 2015). These digital transformations provide new business opportunities and new business models that managers must adopt to thrive in the competitive environment (Pagani & Pardo, 2017). Digital transformation through new business models usually changes the conventional business environment, disrupts numerous markets, and alters consumers' behaviour and expectations (Verhoef et al., 2021). Hence, several industries benefited from digital transformation, for instance, music (i.e., Sound Cloud and Spotify), online retailers (i.e., Amazon and Alibaba), transportation (i.e., Curb and Uber), broadcasting (i.e., Netflix and Prime Video) and travelling (i.e., Booking, Agoda, and Airbnb). The researchers also investigated its role in different technologies such as the internet (Zhu et al., 2006), social media, mobility, analytics, cloud (Berman & Marshall, 2014), and virtual reality (S. A. Lee et al., 2021). Virtual reality (VR) is a novel technology (Nagy & Turner, 2019; Waycott et al., 2018), and recently a substantial potential has been noticed for VR marketing (Loureiro et al., 2019). Therefore, the research on multi-sensory VR demands attention from scholars (Flavián et al., 2019).

The usage of VR, demand, and attention is increasing every day. Thus, good-quality VR devices are now available at an accessible price (Lopez, 2016). Founder of Meta Platforms, Inc. (formerly known as Facebook), Mark Zuckerberg, mentioned the importance of VR in 2014 that *"every 10 or 15 years, there's a new major computing*

platform… And now we're starting to get ready for the platforms of tomorrow... When you put on their goggles, you enter a completely immersive computer-generated environment, like a game, or a movie scene…" (Yung & Lattimore, 2019, p.1). Consequently, businesses showed a keen interest in VR and their VR products are available in the market, for instance, Meta, Sony, Samsung, Google, and HTC (Yung & Lattimore, 2019).

The market value of VR was 7.3 Billion (US-$) in 2018 and it is estimated that the market size of VR will be 120.5 Billion (US-$) by 2026. Although, its usage was evident in different sectors like healthcare, aerospace, defence, training, marketing, tourism and gaming. VR also gained a considerable amount of attention in the entertainment industry due to the spread of Covid-19: where marketers started VR concerts; VR tours as a replacement for an actual trip during the lockdown; and other activities to entertain people while they were staying at their homes (Markets & Markets, 2020; Roger, 2020).

In social sciences, tourism is a sector in which VR is vastly adopted (Marasco et al., 2018). It is predicted that almost half of the millennials will be using VR headsets to preview the destination they are planning to travel to (Cranmer et al., 2018). Therefore, a considerable amount of organisations are using VR for marketing purposes like New York Times, Viking City Waterford, Thomas Cook, Etihad Airways, Legoland Florida, Disney, Europa Park, Marriot hotel, Australian VR Tour, The Louvre Museum Virtual Tour and British Museum (Be there, 2017; Bevil, 2018; S. Hudson et al., 2019; Mbryonic, 2019).

Most VR studies within the tourism context are conducted without involving a specific theory to examine the influence of VR (Bogicevic et al., 2019; S. Hudson et al., 2019; W. Wei et al., 2019; Yung & Lattimore, 2019). Theory-based research in the context of VR got attention after 2019, and researchers prefer those theories that supported data

collection at one time only (see Lo & Cheng, 2020; Rauscher & Humpe, 2022; Wen & Leung, 2021). Contrary, some researchers (Bae, 2018; Bhattacherjee & Premkumar, 2004; Karimi et al., 2014) argue that data collection at two times (pre and post usage) provides an actual situation of attitudinal change, beliefs, satisfaction, and continued usage intention. Thus, scholars should study the pre and post usage experiences.

1.2 Research problems

Uses and Gratifications (U&G) theory is widely used in a technological context. It answers the fundamental question, "Why do people use specific technology/media?" Researchers apply U&G theory to understand the influence of new technologies like TV, email, social media, AR, and VR (Bae, 2018; M. J. Kim, Lee, & Preis, 2020; Palmgreen & Rayburn, 1979; Rauschnabel, 2018a). One important aspect of U&G theory is that it provides an opportunity to examine the gratifications sought (GS) and gratifications obtained (GO), which identifies the motivations and fulfilment gained from using media. GS mainly deals with a person's desire to use a technological medium or refers to gratifications that individuals expect to obtain from a medium before they have come into contact with it (Bae, 2018; Palmgreen & Rayburn, 1979). It is also known as motives in the literature. GO is the outcome received by a person from media (Bae, 2018) or refers to gratifications that individuals actually experience through a particular medium (Palmgreen & Rayburn, 1979).

This discrepancy in GS and GO provides an exact idea about the successful working of a media to meet the user's expectations (Rokito et al., 2019). It is also evident from past research that comparing the results of pre and post usage provides an actual situation of attitudinal change and beliefs (Bhattacherjee & Premkumar, 2004), satisfaction, and continued usage intention (Bae, 2018). Therefore, gratification

discrepancies approach is a suitable theory for this research because it will help in examining user motivation for using multi-sensory VR (Gratifications Sought or Pre-experience) and whether those motivations are fulfilled or not (Gratifications Obtained or Post-experience).

Several variables with U&G theory are used in the literature to study user's gratifications, e.g., information seeking, social interaction, entertainment, pass time, surveillance, expression of opinions, relaxation, information sharing, communicatory and convenience utilities (Ko et al., 2005; Palmgreen & Rayburn, 1979; Whiting & Williams, 2013). Sundar and Limperos (2013) extended the usage of U&G theory by proposing its 2.0 version for new technologies by arguing *"noting that studies on the uses of the Internet have generated a list of gratifications that are remarkably similar to those obtained from older media…gratifications are conceptualised and operationalised too broadly (e.g., information-seeking), thus missing the nuanced gratifications obtained from newer media"* (p. 504). Sundar and Limperos (2013) defined nuanced gratifications as *"new gratifications for new media"* (p. 509). U&G theory 2.0 version provides variables for measuring the gratifications such as being there (telepresence), realism, dynamic control, coolness, novelty, agency enhancement, community building, interaction, activity, responsiveness, browsing, and navigation aids (Sundar & Limperos, 2013). The researchers are trying to explore the impact of these proposed gratifications. However, the researchers still do not empirically study several gratifications, such as being there (telepresence), coolness, novelty, and responsiveness.

Different research models are used to study consumer behaviour, such as attitude, behavioural intention, and satisfaction. These models highlight the interplay of GS and GO and their impact on media choice (Palmgreen & Rayburn, 1985). The literature provides

conflicting suggestions. For instance, some researchers (Bae, 2018; Karimi et al., 2014) argue that GS must be fulfilled to generate positive reactions. Thus, scholars should use the difference score between GO and GS. Other researchers, however, argue that a simple study of GO is sufficient or even better (Sheldon et al., 2017; Sheldon & Bryant, 2016). The literature thus lacks clear recommendations for measuring media gratifications in general and in the particular context of museum VR. Therefore, the literature cannot provide the best model to study the consequences of media consumption by comparing the different frameworks.

After getting the best model, this research also used it to study VR users' reuse and purchase intentions. The primary reason for studying reuse intention was an emerging theme from interviews. Secondly, the literature on VR and tourism discussed the importance of continuance intention (H. Yang & Han, 2020), continued use intention (M. J. Kim & Hall, 2019), and behavioural intention to use VR in tourism (Tussyadiah et al., 2018; Vishwakarma et al., 2020a, 2020b). But, researchers have overlooked the reuse intention at tourism destinations (e.g., museum). The literature also empirically proves that reuse intention plays an important role in predicting consumer behaviour (H. B. Kim et al., 2009; So & Kim, 2013). Purchase intention is also considered because of the visitors' motivations for using VR (discussed in sub-section 4.4). Several researchers have studied purchase intention in the context of VR and tourism. For example, Jeng et al. (2016) investigated the purchase intention of a product, Lo and Cheng (2020) explored the purchase intention after experiencing the VR of a hotel advertisement, Wen and Leung (2021) studied the purchase intention for wine, and Willems et al. (2019) investigated the tour purchase intention. However, researchers have overlooked the study of purchase intention of VR. It is also evident from the literature that users want to purchase a technology after using it (S.-H. Kim, 2010).

Loureiro et al. (2019) conducted a literature review of 150 research documents published on VR marketing. They argued that *"previous studies tend to regard constructs such as pleasure, arousal, vividness and telepresence as mediators between stimuli and behavioural intentions. However, we suggest other mediators…" (p. 12).* One important mediator is pleasantness of experience (Horng & Hsu, 2021), which has not been studied in VR literature. Pleasantness of experience is a collection of positive and negative emotions. It deals with the outcomes of a product or service, for example, happy or unhappy, satisfied or unsatisfied, pleased or annoyed, relaxed or bored, and others (Van Kerrebroeck et al., 2017a). From the theoretical perspective, roots of pleasantness of experience can be traced back from the hedonic theory, also known as the theory of psychological hedonism. It posits that human behaviour is driven by the pursuit of pleasure and the avoidance of pain or displeasure. It received prominence within the fields of psychology, behavioural sciences, and neurology (Angelino et al., 2021; Horng & Hsu, 2021). Pleasantness of experience is crucial in the context of immersive media because it directly affects the user's level of engagement. VR creates a sense of presence and transports users to new worlds. However, users can detract from the overall immersive experience if they feel discomfort, such as unpleasant sensory experiences, discomfort from wearing a VR headset, or motion sickness. Therefore, studying pleasantness of experience is essential to understand user behaviour.

1.3 Research scope

The scope of this study is to understand visitors' needs for using multi-sensory VR. Interviews are conducted from the visitors of VRlab of Deutsches Museum, Munich to consider constructs based on their needs. Furthermore, this research compares different models of gratification discrepancies approach and proposes one best suitable model to

measure media consumption consequences. Entertainment, education, novelty, and telepresence are used as independent variables. Controlled variables are age, gender, VR familiarity, and respondents' education, whereas pleasantness of experience is the dependent variable. Seven models are compared in which three models are weighted by user's personal importance: (i) gratifications sought model ∑(GS), (ii) gratifications obtained model ∑(GO), (iii) simplified discrepancy model ∑(GO - GS), (iv) discrepancy weighted by users' personal importance model ∑ *j*(GO - GS), (v) transactional model of model iii ∑(GS+GO), (vi) transactional model of model iv ∑ *j*(GS+GO) and (vii) modified gratifications obtained model ∑ *j*(GO). In the literature, user's personal importance for gratifications was not studied. It is the degree of affect – positive or negative – toward an attribute or behavioural outcome. All visitors do not shape their GO in the same way. For instance, consider two visitors; the first one is highly interested in learning about the topics shown in VR, whereas the second one is highly interested in getting entertained. Both might have similar GS of how entertaining the VR content is, but whether these GS are actually met will matter much more for the second visitor who has a strong wish to get entertained than for the education-focused visitor. Hence, empirical study of personal importance demands attention. Furthermore, this study also investigates the role of gratifications obtained on reuse and purchase intentions through the mediating role of the pleasantness of experience.

1.4 Objectives of the study

The objectives of this study are mentioned below:

1. To identify the visitors' needs for using multi-sensory VR and emerging gratifications based on those needs

2. To analyse the discrepancies between gratifications sought and gratifications obtained from multi-sensory VR
3. To assess the effectiveness of multi-sensory VR in promoting education during tourism activities
4. To determine the best model among various models in measuring the consequences of media consumption
5. To examine the mediating role of pleasantness of experience between gratifications obtained and behavioural intentions

Technological mediums have unique tendencies to fulfil specific gratifications. For example, social media fulfils social needs (Basilisco & Jin, 2015; Ha et al., 2015; Korhan & Ersoy, 2016). AR Pokémon games fulfil challenge, achievement, social interaction (Ghazali et al., 2019a, 2019b), nostalgia, enjoyment, physical activity, flow, and image improvement (Rauschnabel et al., 2017). Hence, there exists a research gap in identifying the visitors' needs for using multi-sensory VR and emerging gratifications based on those needs (see research objective 1).

The existing VR literature in tourism overwhelmingly discusses the positive experience formed by collecting data at one time without exploring the needs of a tourist. Contrary, researchers believe that real experience from technology can be studied by identifying the tourists' underlying needs for using technology, emerging expectations based on those needs (Rauschnabel, 2018b), and fulfilling expectations after using that technology (Palmgreen & Rayburn, 1979, 1985). The study of users' needs for using technology is a cornerstone of user-centered design, innovation, and market success. It ensures that technology is not just functional but genuinely valuable and relevant to its intended users (Kraft, 2012). Furthermore, as discussed earlier, several scholars also

professed the method of studying pre and post-media usage as a suitable way to measure attitudinal change, beliefs, satisfaction, behavioural intention, and behaviour (Bae, 2018; Bhattacherjee & Premkumar, 2004; Rokito et al., 2019). Pedagogical research deals with the gratifications of using VR (M. J. Kim, Lee, & Preis, 2020) but does not explain about the fulfilment of those gratifications. Consequently, the second objective of this research is to analyse the discrepancies between GS and GO from multi-sensory VR.

One of the core ideas is that well-developed VR content can motivate students and thus, allow them to deeply immerse in the topic (Lau & Lee, 2015). However, in a museum context, users are not in a specific learning context, process several short experiences about different topics (with basic baseline interest), and might not just use it exclusively for learning purposes. Hence, the third objective is to study the impact of VR in providing education along with entertainment. As recommended by Loureiro et al. (2020), to research virtual experience in which a person can travel to another period of time to get an education along with entertainment, especially in the context of tourism.

In academic literature, the gratification discrepancies approach has rarely been studied (Bae, 2018), a research objective two. The present literature lacks the comparison of different models through robust statistical analysis dealing with the user's personal importance, GS, and GO. Therefore, due to scant research to understand and uncover the best suitable model to study gratifications, this research compares different models by using strong statistical analysis, i.e., SEM. These models are gratifications obtained model $\sum$ (GO), simplified discrepancy model $\sum$ (GO-GS), and transactional model $\sum$ (GS+GO). Four other models are also studied that were overlooked in the literature, such as the gratifications sought model $\sum$ (GS), discrepancy model weighted by users' personal importance $\sum j$(GO-GS), modified gratifications obtained model $\sum j$(GO), and

transactional model $\sum j$(GS+GO). Fifth objective deals with the reuse and purchase intentions of VR, along with the mediating role of pleasantness of experience.

1.5 Research questions

The following research questions are proposed based on the above-mentioned discussion:

1. What are the visitors' needs for using multi-sensory VR experiences in museums?
2. What is the role of gratifications sought and gratifications obtained in providing pleasantness of experience?
3. What is the effectiveness of multi-sensory VR in promoting education during tourism activities?
4. What is the best suitable model to measure the consequences of media consumption?
5. Does pleasantness of experience mediate the relationship between gratifications obtained and behavioural intentions?

1.6 Research contributions

This subsection is designed to describe the contributions of this research in three ways: (a) conceptual and empirical, (b) methodological, and (c) managerial (Ghazali, 2011).

1.6.1 Conceptual and empirical

The extant literature lacks research on virtual experience in which a person can travel to another period of time to get an education along with entertainment (Loureiro et

al., 2020). This research unfolds about the VR experience to provide an educational experience to visitors, which is only studied twice in literature by collecting data at a single time (Jung et al., 2016; H. Lee et al., 2020). Furthermore, this research also utilises some of the under looked nuanced gratifications proposed by Sundar and Limperos (2013) in the 2.0 version of U&G theory. These nuanced gratifications are novelty and telepresence because novelty and telepresence are not empirically studied with VR and U&G theory, respectively.

We live in a world where multi-sensory experiences play a vital role in the existence of nearby things and lives. All human experiences are formed through the stimulation of multiple senses. Therefore, academic literature highlights the importance of audio-visual elements during digital interactions. The important aspect of VR is to provide a multi-sensory experience that is empirically investigated in the literature by Flavián et al. (2019, 2021b), Hopf et al. (2020), Melo et al. (2022), Wen and Leung (2021). Flavián et al. (2019) conducted research by collecting data from three experimental groups with different VR sources (desktop PC, mobile phones, and VR headsets) dealing with the senses of vision and hearing only. Flavián et al. (2021b) used an additional element of scent along with the audio-visual. Hopf et al. (2020) studied haptic and olfactory experience along with the visual and auditory VR experience, whereas Wen and Leung (2021) included the taste of a wine. Melo et al. (2022) experimented by providing two VR stimuli (audiovisual vs multi-sensory). Multi-sensory VR was able to provide wind and smell along with the audiovisual. Still, other sensory stimuli such as taste, walk, touch, and feel of sitting are less explored. Also, multi-sensory VR is not studied with U&G theory and the GO-GS approach, which needs researchers' attention. This leaves a question of how visitors interact with multi-sensory VR that provides the feeling of walking in a virtual

environment, observing VR content by sitting and teleporting at different locations with the help of a joystick together with vision and hearing. The same is mentioned by Loureiro et al. (2019) that: *"multi-sensory simulations in VR studies and the implications for consumer behaviour are recommended for contexts such as retail, education, hospitality and destination, and manufacturing"* (p. 13).

Another objective of this research is to provide a deep insight into the visitors' needs for using multi-sensory VR, gratifications sought and obtained. For this purpose, the discrepancy approach from U&G theory is used to comprehend the visitors' behaviour. Rokito et al. (2019) also explained the little attention of the researchers towards GS and GO. Moreover, as discussed earlier, most of the work in VR and tourism is conceptual. The same is explained by Bogicevic et al. (2019, p.55), *"limited empirical knowledge about the application of virtual reality (VR) in tourism."* Therefore, empirical research on the topic of needs, gratifications sought and obtained in multi-sensory VR and tourism is an important contribution of this research. Furthermore, this research also assesses different models by using complex statistical analysis such as structural equation modelling (SEM), which will suggest academicians and practical researchers to use one best model for future research.

1.6.2 Methodological

As discussed earlier, this research is a pioneer in studying visitors' needs for using multi-sensory VR, emerging GS based on those needs, and GO after using VR. Therefore, this research demanded a rigorous methodology to address the aforementioned research gaps. Interviews were conducted to identify the needs and emerging gratifications based on

those needs. The cross-sectional survey design was used to collect data at two times: before and after VR use from visitors visiting the VRlab of Deutsches Museum, Germany.

1.6.3 Managerial

This research has unearthed the comparison of gratifications sought and obtained with different conceptual models to predict the pleasantness of experience. It is of substantial importance for tourism marketers and VR content creators to get deep insights into the gratifications that are expected by a visitor and whether those gratifications are being fulfilled or not. At the end of this thesis, suggestions are provided for managers to help them create a pleasant experience so that users reuse VR and purchase it for their personal use.

1.7 Overview of the Thesis

The first chapter highlights the background of the research, research questions, objectives, and contributions of this research. The second chapter discusses U&G theory, GO-GS discrepancy approach, VR, literature published on VR & tourism, and other competing theories. The third chapter develops the conceptual framework and hypothesis, whereas the fourth chapter presents the interviews, questionnaire development, data collection method, and data analysis. The fifth chapter presents the results, sixth chapter discusses the results, and the seventh chapter concludes the thesis.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The literature review is developed based on existing literature dealing with uses and gratifications theory, gratification discrepancies approach, virtual reality, and VR in tourism to highlight the research gaps. The literature review first discusses the U&G theory and GO-GS approach, followed by the discussion and literature review of virtual reality, implications of virtual reality in tourism, and competing theories. While the main concern of the current study is the implication of VR in consumer behaviour research, therefore, this research also discusses the role of traditional technologies in consumer behaviour literature. The reason for this is to get the basis for conceptualising the research and providing evidence for adapting the phenomenon. In the end, research gaps and their importance are discussed based on a literature review before summarising the chapter.

2.2 Uses and gratifications (U&G) Theory

According to Katz et al. (1974), uses and gratifications theory deals with *"(1) the social and psychological origins of (2) needs, which generate (3) expectations from (4) the mass media or other sources, which lead to (5) differential patterns of media exposure (or engagement in other activities), resulting in (6) need gratifications and (7) other consequences, perhaps mostly unintended ones"* (p. 20). The basic premise of U&G theory is an *active audience* – technology users actively select a media and interact with it to fulfil their needs that leads to behavioural outcomes. This theory assumes that audience members are not passive consumers of a media (Katz et al., 1974; Lariscy et al., 2011). In simple words, people have some needs to be fulfilled by using media, and they prefer those media that can help them fulfil those needs (Levy & Windahl, 1984). In this regard, the audience needs must be given preference to all other aspects of a media. For example,

social media can fulfil social needs; hence, people seeking socialisation prefer to use social media (Basilisco & Jin, 2015; Ha et al., 2015; Korhan & Ersoy, 2016). In the same way, people interested in improving their English prefer to watch English movies, read English newspapers, books, telephone conversations, or any other media that is easily accessible to the audience. Katz et al. (1973) also described an important phenomenon that audience can satisfy their needs by using other sources. For instance, the need for socialisation can also be achieved through meeting someone, and improvement in English can also be done through individual pieces of paper, face to face conversation, or some older ways. Hence, media must fulfil users' needs; otherwise, they can shift to other sources.

Katz et al. (1974) provided in-depth details for the working of U&G theory: key concepts, theoretical background, and explained the three main sources of audience gratification. These three sources are content of a media, exposure from media and social context. The reason for introducing the U&G theory was the lack of a specific theory dealing with users' social and psychological needs for using mass media. Katz and colleagues proposed a theory to understand the users' needs and motivations to use mass media. Before U&G theory, the foremost literature dealt with the effects of media on users. Later, researchers started to integrate active audiences, motivations and needs with media effects research, e.g., television and radio (de Bock, 1980; Houghton-Larsen, 1982; Palmgreen & Rayburn, 1979). Therefore, U&G theory is being studied with different technologies to understand consumer behaviour, for example, satisfaction from e-commerce (Luo, 2002), purchase intentions formed through the website (Ko et al., 2005), social media usage behaviour (Whiting & Williams, 2013), television migration behaviour (Shade et al., 2015), AR usage behaviour (H. F. Lin & Chen, 2017), and behavioural intention through VR (M. J. Kim, Lee, & Preis, 2020).

The researcher acknowledges that while the literature review primarily focused on the uses and gratifications literature, which is a media and communication theory that deals with the basic premise of why people use specific media, a wider and arguably more useful literature exists in other research areas that do not fall within the scope of this study and therefore not discussed in the review. Furthermore, these three systematic literature reviews demonstrate a deeper understanding of the U&G literature, gratification discrepancies approach, and VR in tourism, and also provide potential future research directions that are beyond the scope of the current study.

2.2.1 U&G with traditional media

Uses and gratifications theory is studied with traditional media, for instance, motives for using print media, radio, and television (Ruggiero, 2000). Holmlöv (1982) studied the gratifications for reading the local newspaper. The respondents reported two main gratifications for example, (i) immediate rewards (pleasure-seeking, likeness, relaxation) and (ii) delayed rewards (instrumental and cognitive). These gratifications were used to predict the knowledge score. The change in knowledge score was more for respondents with a primary motive of learning than those with a motive of fun. Holmlöv concluded that *"predictors tapping aspects of community involvement and family life are also rather predictive… knowledge could be cummulated in a family where both adults are well educated and both bread-winners"* (p. 319).

Towers (1987) reported different gratifications for using news and general circulation magazines. He concluded that interaction and surveillance motives predicted the use of news magazines, while diversion predicted the use of consumer magazines. Payne et al. (1988) further extended the study of Towers (1987) and investigated several gratifications for reading two different magazines such as consumer magazines and trade

magazines. The respondents reported interaction, surveillance, and diversion motivations for reading a magazine. Diversion motivation for reading consumer magazines was more. Contrary, interaction and surveillance motivations were more for trade magazines. It provided strong support that uses of particular media types can be predicted from the content of a medium.

Bluebond (1982) highlighted the gratifications of using public radio. The primary motives were special programming, news, and entertainment, whereas the least likely reasons were the transmission of culture and diversion from routine. Bluebond's research played an important role in the context of U&G theory and radio. The researchers followed his suggestions to find out the uses and gratifications of all radio – not just public radio (Towers, 1987). Armstrong and Rubin (1989) identified several gratifications for calling talk radio programmes and listening to the radio. Listening gratifications were related to communication and social variables, whereas time spent listening, communication, and affinity were associated with calling talk radio programmes.

Researchers mostly study the gratifications of watching television. Therefore, academic literature related to traditional media is overwhelmed with articles published on television media. Greenberg (1974) concluded several gratifications for watching television among British children: (1) escape, the motive for getting away from rest of the family and from what they were doing; (2) companionship, which is a motive to be with someone; (3) habit, the motive for a regular or settled tendency; (4) relaxation, the motive to be free from anxiety and stress; (5) enjoyment, the motive to get fun while watching television; and (6) pass time, the motive to watch television for passing the time. These six gratifications accounted for 56% of the common variance. Hence, Greenberg suggested identifying other gratifications as well.

Blumler (1979) investigated adults' gratifications for television watching and concluded four immediate gratifications. These gratifications are surveillance (also known as information seeking), to get personal relationships (also categorised as companionship), diversion (to escape from the present situation), and personal identity (self-learning). Rubin (1983) categorised these general gratifications into two specific groups. The first group contains those gratifications that are related to passing time and getting entertainment, while the second group presents gratifications dealing with information seeking and learning. Afterwards, Rubin (1984) named this categorisation as ritualistic and instrumental. The ritualistic group had gratifications such as escape, relaxation, companionship, and arousal. Contrary, the instrumental group had information seeking and learning. Farquhar and Meeds (2007) conducted interesting research in which they found that surveillance and arousal are two primary gratifications for watching television. These two gratifications were more important than social interaction, escapism, and entertainment.

Many researchers also investigated the gratifications for watching specific programmes on television. For example, Palmgreen et al. (1980, 1981) researched the viewership of three news programmes: CBS's Evening News, ABC's World News Tonight, and NBC's Nightly News. The viewers reported the following gratifications for watching news programmes: general information seeking, decisional utility (to know about the issues and what government officials are doing), entertainment, interpersonal utility (something to discuss with others), and parasocial interaction (reporters add human quality in News and to compare own views with their News). Palmgreen and colleagues highlighted a very important factor that individuals who only watched a single programme were less aware than those who watched several programmes. They also suggested

studying the gratification discrepancies approach with different TV programmes. Wenner (1982) replicated the studies of Palmgreen et al. (1980, 1981). Wenner also reported gratifications such as surveillance, entertainment, interpersonal utility, and parasocial interaction for watching evening news programmes. These researchers made a breakthrough contribution to the literature on U&G theory and television, which is also appreciated in today's era. For instance, Barton (2009) investigated the motives for watching reality TV programmes based on the research of Palmgreen et al. (1980, 1981). Barton concluded that the viewers' gratifications for watching reality TV programmes were (a) to pass time, (b) to get perceived reality (a programme that shows real situations faced by real people), (c) to do vicarious participation (participation in the programme), (d) to get social utility (to learn something that can help in social interactions), and (e) to get personal utility (entertainment and relaxation). Barton (2009) used a new gratification with U&G theory for reality programming that is a personal utility. Hence, supporting the basic argument for using media-related gratifications.

Habes (2019) investigated the impact of viewers' motivation on online social TV. It compared traditional television viewing with social TV and explored content learning. This study identified key motivations like relaxation, routine, information access, learning, entertainment, and social connections. Vaterlaus et al. (2019) investigated gratifications and perceived consequences for television binge-watching among college students. Respondents recognised potential health effects and isolation associated with binge-watching, but several reported it as a social activity to make new friends.

2.2.2 U&G with social media

Social media is a website or mobile phone application through which users can socially interact with others. Social media started its growth during the first decade of the

21st century and reached its boom during the second decade. Social media has 3.72 billion 'active' users worldwide, with an addition of 10 new users every second. On average, each person spends 142 minutes per day, and 81% of teenagers have reported a positive impact of social media in their lives. Facebook is a widely used social media with 2.45 billion users, followed by YouTube with 1.9 billion users, WhatsApp with 1.6 billion, Instagram and WeChat with 1 billion users (K. Smith, 2019b). Social media is the only media in history that has seen a huge success. For instance, Facebook was launched in 2004, and now it is the biggest social platform in the World. Another success story is Instagram, launched in 2010 as a mobile video and photo-sharing application. Currently, it has more than 1 Billion active monthly users (K. Smith, 2019a) and is considered one of the best social media applications worldwide (Sheldon et al., 2017). Instagram users can instantly take, edit and upload high-quality photos and videos by applying filters and captions with the hashtag. Moreover, celebrities and brands promote themselves by sharing photos and videos on Instagram (Leaver et al., 2020). Almost 96 % of the fashion brands in the US are on Instagram, and brands have the most consumer engagement on Instagram. It is 10% more useful in engaging customers than Facebook (K. Smith, 2019a). More than 500 million stories are shared on Instagram with 3.5 billion likes per day.

There has been a considerable increase in social-computing online communities where members contribute information in various forms in recent years. Participants' contributions to the content of these communities are vital to their viability; thus, it is important to understand what motivates people to participate and share information with others in these environments. Because of social media's importance, it has become a priority for scholars to study the role of social media in the field of social sciences (Rauschnabel et al., 2019). U&G theory is widely adopted in social media

literature due to its audience-centred approach, which explains that users have certain needs and use media to fulfil those needs (Whiting & Williams, 2013). Most importantly, it provides a chance to study gratifications related to the specific media. For example, sharing videos and photos on social media fulfils users' intrinsic and extrinsic needs (Nov et al., 2010). Nov et al. (2010) investigated the parameters linked to different types of participation in a big online photo-sharing community. Individual motives (both extrinsic and intrinsic) that support user engagement and their effects on various types of information sharing were discovered.

Sharing photos can help fulfil social interaction needs such as self-presentation, self-expression, social relationships, and communication with others (Malik et al., 2016). Malik and colleagues investigated users' gratifications for photo sharing for the first time. Age was positively associated with disclosure and social influence gratifications; gender differences were discovered among habit and disclosure gratifications; the number of images shared was adversely associated with habit and information sharing gratifications. The study findings can be used to improve existing features and services that connect digital photos and social networking sites (Malik et al., 2016). Some users share photos because of technological affordances, social connection, seeking and showcasing experiences, and reaching out (Oeldorf-Hirsch & Sundar, 2016). These results suggest that photo sharing is driven by social needs and facilitated by interface features with important implications for theories of technology and user psychology (Oeldorf-Hirsch & Sundar, 2016).

Several other gratifications of using social media are information, entertainment, socialisation, social support, social escapism, convenience (Bae, 2018), fashion, relationship maintenance (Ku et al., 2013), surveillance, documentation, coolness, and

creativity (Sheldon & Bryant, 2016). The gratifications mentioned above are studied with different media such as Facebook (Basilisco & Jin, 2015), Twitter (Gibbs et al., 2014), Instagram (Sheldon et al., 2017), Tinder (Nair & Padmakumar, 2020), Snapchat (Flecha-Ortíz et al., 2021), TikTok (Scherr & Wang, 2021), KakaoTalk (H. Kim, 2020), microblog and WeChat (Y. Zhang et al., 2022). Therefore, it resulted in one of the mostly used theories with social media.

2.2.3 U&G with extended reality media

Recent advances in information technology – high-speed mobile Internet, artificial intelligence, increased computing power, and high-resolution displays – create new ways for users to experience reality (Dwivedi et al., 2020; Hoyer et al., 2020). Important industry players have developed many devices, brands, and labels to position themselves in this market. For example, Microsoft is promoting its Hololens as a "Mixed Reality" (MR) device (Rauschnabel, 2018). Meta purchased Oculus – a VR company (Hoffman et al., 2014), to complement their primary social media products. PTC discusses "Assisted Reality" as a new reality format for warehousing companies (Coon, 2018). Apple touted AR as a technology that will disrupt the world (Raymundo, 2016). Furthermore, Deloitte (2018) often uses the term "Digital Reality", and Accenture embraces "Extended Reality" (Raghavan & Rao, 2018).

Rauschnabel et al. (2022) proposed a complementary approach to define, organise, and conceptualise common reality formats. They proposed the xReality framework that separates AR from VR based on whether the physical environment plays a role in the user's experience or not. If yes, the experience is a type of AR; if no, and the experience is purely virtual, it is VR. In order to specify AR and VR in more detail, the framework provides two continua: the AR continuum ranges from Assisted to Mixed Reality with local presence forming the core distinction between poles. The VR continuum ranges from

atomistic to holistic, where the level of telepresence is the primary discriminating factor between these poles (Rauschnabel et al., 2022).

Several researchers have investigated the gratifications for using these reality media. For example, Ghazali et al. (2019a, 2019b) studied gratifications (challenge, achievement, social interaction, escapism) for playing AR Pokémon games and found that challenge, achievement, and social interaction positively influence enjoyment that ultimately affects continuance intention to play and purchase. Jang and Liu (2019) also investigated the gratifications for playing AR Pokémon games. They concluded that users prefer to get entertainment, catch Pokémon, pass time, and social interaction. Rauschnabel et al. (2017) also highlighted several gratifications for playing AR Pokémon games, such as nostalgia, enjoyment, physical activity, flow, and image improvement. Rauschnabel (2018b) investigated gratifications for using AR smart glasses (ARSG) and reported that consumers used ARSG to get life efficiency, enjoyment, socialising, self-expression, desired enhancement of reality, and wearable comfort. Contrary, only one article explored the gratifications related to VR. For example, M. J. Kim, Lee, and Preis (2020) mentioned the playfulness, informativeness, and social interactivity gratifications of using VR.

One important aspect of U&G theory is that it provides an opportunity to examine the gratifications sought and gratifications obtained, which identifies the motivations and fulfilment gained from using media. This discrepancy in GS and GO provides an exact idea about the successful working of a media to meet the user's expectations (Rokito et al., 2019). It is also evident from past research that comparing the results of pre and post usage provides an actual situation of attitudinal change and beliefs (Bhattacherjee & Premkumar, 2004), satisfaction, and continued usage intention (Bae, 2018). What is lacking thus far from a more contemporary look at genre-specific uses and gratifications research is an in-depth understanding of the GS and GO association with VR. The absence of literature on these subjects led directly to the main research gap in the current study. Consequently, a

research gap develops a need to examine user motivation for using multi-sensory VR (Gratifications Sought or Pre-experience) and whether those motivations are fulfilled or not (Gratifications Obtained or Post-experience).

2.2.4 Extension of U&G theory

Initially, U&G theory was used to measure the gratifications at one point in a time, which was unable to explain the expectations from the media and the fulfilment of those expectations after using media. Palmgreen and Rayburn (1979) introduce the gratification discrepancies approach to fill this void. Specifically, the attraction to reuse a media depends on the gratifications obtained against the gratifications sought. The obtained outcome of a technology/media experience must exceed the expectation (i.e., GO > GS) to get the user's engagement and positive behaviour towards the adoption of a technological medium (Ko et al., 2005; H. F. Lin & Chen, 2017; Palmgreen & Rayburn, 1979). It explains the gratifications sought and obtained concerning the fulfilment of expectations among the users of the technological medium.

As previously mentioned, U&G theory has several variables like social interaction, information seeking, pass time, entertainment, relaxation, expression of opinions, information sharing, surveillance, communicatory and convenience utilities (Ko et al., 2005; Palmgreen & Rayburn, 1979; Whiting & Williams, 2013). With the advent of U&G theory 2.0, there has been an extension in theory concerning its use for modern technologies. Version 2.0 provide variables for measuring motivation like being there (telepresence), realism, dynamic control, coolness, novelty, agency enhancement, community building, interaction, activity, responsiveness, browsing, and navigation aids (Sundar & Limperos, 2013). Researchers are trying to study the role of these nuanced gratifications on consumer behaviour, but several gratifications are not empirically studied

yet. Therefore, a systematic literature review of U&G theory is being conducted to highlight the potential gratifications for further research.

SLR methodology for U&G theory is discussed in section 4.2.1. More than 100 empirical papers are considered based on the results of a search string that covers diverse research areas and technologies. It has been noticed that U&G theory is being used with all types of technologies like printed media, radio, television, World Wide Web, video games, smartphones/tablets, social media, virtual and augmented reality (see Table 2.1). The list of gratifications used in these research articles is very broad. Some gratifications are being used with almost every technology like information, entertainment, and relaxation. Contrary, most of the gratifications are related to a specific technology: gratification of socialisation in the context of social media; escapism with VR; map navigation with a smartphone; challenge with video games; wide exposure with the internet; contest-excitement with printed media and television. Existing literature deals with the implication of U&G theory with virtual reality (M. J. Kim, Lee, & Preis, 2020), especially the usage of VR in tourism as well (W. Wei et al., 2019). However, still, literature is unable to explain the GO-GS discrepancies of VR in tourism. Moreover, researchers still do not empirically study several gratifications with reality media formats, such as telepresence, coolness, novelty, and responsiveness.

Table 2.1: Articles published using U&G theory

Media	Gratifications	References
Print Media	Surveillance, diversion, interaction, entertainment, pastime, relaxation, information, personal identity, social interaction, transformation, guidance, inspiration, retrospection, social prestige, respite, occupation, ritual, security, companionship, forget loneliness, contest-excitement, communication utility, habitual, follow celebrities, loving sports	(C. Carter, 2013; de Bock, 1980; Garramone, 1984; Houghton-Larsen, 1982; J. Kim et al., 2015; McLeod et al., 1982; Payne et al., 1988, 2003; Randle, 2003; Van Reijmersdal et al., 2005; Wang & Tchernev, 2012; M. Wei, 2009)
Radio	Relaxation, entertainment, information, companionship, forget loneliness, habitual, pastime, variety-seeking, education, communication, diversion, surveillance, habit, follow celebrities, loving sports	(Albarran et al., 2007; Houghton-Larsen, 1982; C. A. Lin, 2006; Safi & Iqbal, 2015; Wang & Tchernev, 2012; M. Wei, 2009)
Television	Information, social prestige, respite, occupation, ritual, security, Personal utility, social utility, pass time, perceived reality, vicarious participation, schadenfreude, surveillance, relaxation, entertainment, diversion, contest-excitement, communication utility, decisional utility, habitual, follow celebrities, loving sports	(Barton, 2009, 2013; de Bock, 1980; Garramone, 1984; Houghton-Larsen, 1982; Levy & Windahl, 1984; C. A. Lin, 1993; McLeod et al., 1982; Palmgreen et al., 1980, 1981; Palmgreen & Rayburn, 1985, 1979; Rayburn et al., 1984; Wang & Tchernev, 2012; M. Wei, 2009; Wenner, 1982, 1986)
Internet/ WWW	Surveillance, diversion, interaction, entertainment, pastime, relaxation, information seeking, socialization, follow celebrities, loving sports, self-expression, extrinsic rewards, convenience, access to information, escape, intertext, anonymity, process, pleasing visuals, self-development, wide exposure, user-friendly, career opportunities	(C. Chou & Hsiao, 2000; Cuillier & Piotrowski, 2009; Khang et al., 2013; Ko et al., 2005; Larose et al., 2001; X. Liu et al., 2020; Payne et al., 2003; Randle, 2003; Roy, 2009; Stafford et al., 2004; M. Wei, 2009; Yoo, 2011)
Video Game	Action, companionship, passing time, solitude, substitute for friend, Seeking fantasy, seeking information & reflection, positive virtual engagement, virtual distractions, emotional, competition, challenge, tension release	(B. H. Chang et al., 2006; Ferguson & Olson, 2013; Ghazali et al., 2019b, 2019a; Granic et al., 2014; Greenberg et al., 2010; Jang & Liu, 2019; Jansz & Martens, 2005; Khang et al., 2013; Lucas & Sherry, 2004; Palomba, 2018; Rauschnabel et al., 2017; Sherry et al., 2012; Sjöblom & Hamari, 2017)
Smartphone/ Tablet	Relaxation, personal influence, social influence, global influence, sexually explicit content, emotional, cognitive, habitual, pass time, accessibility, following the trend, caring for others, escapism, entertainment, instant messaging, email, internet/websites, games, music/podcasts/radio, taking pictures/videos, watching videos/TV/movies, reading books/magazines, maps navigation	(Ahad & Anshari, 2017; Elhai et al., 2017, 2018; Harun et al., 2015; Joo & Sang, 2013; Khang et al., 2013; J. H. Kim, 2017; T.-Y. Kim & Shin, 2013; L. Leung & Zhang, 2016; N. Park & Lee, 2012; Reychav & Wu, 2014; Sutanto et al., 2013; Wang & Tchernev, 2012; Wolniewicz et al., 2018)

Social Media	Seeking friends, social support, entertainment, information, convenience, escapism, interaction, promotion, pastime, sociability, self-relief, self-affirmation, organizing, designing, conforming, trendgaging, inspiring, reaching, summarizing, endorsing, maintain relationship, meet new people, realism, high-tech, social events, status seeking, sharing photos & videos	(Bae, 2018; Basilisco & Jin, 2015; Dolan et al., 2016; Ezumah, 2013; Froget et al., 2013; Gibbs et al., 2014; Korhan & Ersoy, 2016; C. S. Lee & Ma, 2012; Rauschnabel et al., 2019; Rokito et al., 2019; Sheldon, 2008; Z. Wang et al., 2012)
Virtual/ Augmented Reality	Hedonic, emotional, social, social interactivity, sensual, symbolic, utilitarian, achievement, escapism, challenge	(Geng et al., 2023; Ghazali et al., 2019b, 2019a; Hwang et al., 2023; Jang & Liu, 2019; M. J. Kim, Lee, & Preis, 2020; Rather et al., 2023; Rauschnabel, 2018b; Rauschnabel et al., 2017)

2.3 GO-GS

Gratifications sought and gratifications obtained discrepancies approach for U&G theory was initially proposed by Palmgreen and Rayburn (1979) to address the lacking in U&G theory to measure the gratifications for using media and results obtained after the use of media. Uses and gratifications theory, for the first time, made a distinction between GS and GO. GS mainly deals with a person's desire to use a technological medium or refers to gratifications that individuals expect to obtain from a medium before they have come into contact with it. It is also known as motives in the literature. GO is the outcome received by a person from media (Bae, 2018) or refers to gratifications that individuals actually experience through a particular medium (Palmgreen & Rayburn, 1979). The present literature highlighted that GO influences media usage and recurring media use (Kaye & Johnson, 2002; Palmgreen & Rayburn, 1979).

GO-GS approach explained that the gratifications for using the media are not always the same as those obtained after the use (Palmgreen & Rayburn, 1985). In simple words, it is not necessary that the gratifications user had sought were always obtained from the media or that the gratifications that had been obtained were sought by the user. There are three possibilities after using media, i.e., fulfil GS, over-fulfil GS, or under-fulfil GS. The technological medium must fulfil GS (GO=GS), and it is ideal to over-fulfil GS in which GO is more in comparison to GS, i.e., GO > GS (Palmgreen & Rayburn, 1979). Over-fulfilment of GS results in adopting a medium, frequent usage, and more dependency. While, under-fulfilment occurs when a medium cannot fulfil the GS and performs less than the expectations (Palmgreen & Rayburn, 1979; Wenner, 1986). This discrepancy is also directly linked with the satisfaction from the media (Palmgreen & Rayburn, 1985) and the continuance usage behaviour (Rokito et al., 2019). Several

scholars professed the method of studying pre and post media usage as a suitable way to measure attitudinal change, beliefs, continued use intentions, and satisfaction (Bae, 2018; Bhattacherjee & Premkumar, 2004). This approach is being studied by researchers with several media like radio and magazines (Houghton-Larsen, 1982), written memos (Dobos, 1992), television (Barton, 2009), social media (Bae, 2018), and video games (Palomba, 2018).

2.3.1 SLR of gratification discrepancies approach

SLR methodology and Prisma framework of GO-GS literature are discussed in section 4.2.2.

2.3.1.1 Overview of articles

This sub-section discusses the journals that published these 23 research articles and the research methodology used in them.

Publication outlets

The list of all articles published by the journals is given in Table 2.2. The Communication Research journal published six articles, while Computers in Human Behavior disseminated three articles. Journalism Quarterly and Communication Monographs published two articles each, and the journals that published one article are listed in Table 2.2. The number of published articles related to the GO-GS approach has decreased over time (Table 2.3). A total of 13 articles were published from 1979–1999, whereas only ten were published from 2000 to 2022.

Table 2.2: Journals disseminated GO-GS research

Journals	#	References
Communication Research	6	(Dobos, 1992; Levy & Windahl, 1984; Palmgreen et al., 1980, 1981; Palmgreen & Rayburn, 1979; Wenner, 1982)
Computers in Human Behavior	3	(Bae, 2018; Palomba, 2018; Rokito et al., 2019)
Journalism Quarterly	2	(McLeod et al., 1982; Rayburn et al., 1984)
Communication Monographs	2	(Palmgreen & Rayburn, 1985; Wenner, 1986)
Journal of Broadcasting & Electronic Media	1	(Barton, 2009)
Communication Quarterly	1	(Barton, 2013)
Journalism & Mass Communication Quarterly	1	(Garramone, 1984)
International Journal of Sport Communication	1	(Gibbs et al., 2014)
Canadian Journal of Communication	1	(Houghton-Larsen, 1982)
Information discovery and delivery	1	(Hussain et al., 2020)
Contemporary Educational Technology	1	(Karimi et al., 2014)
Human Communication Research	1	(C. A. Lin, 1993)
Journal of Communication	1	(Wang & Tchernev, 2012)
Communication Theory	1	(Yoo, 2011)

Table 2.3: Publishing trends from 1979 to 2022 for GO-GS research

Year	Number of articles
1979	1
1980	1
1981	1
1982	3
1984	3
1985	1
1986	1
1992	1
1993	1
2009	1
2011	1
2012	1
2013	1
2014	2
2017	1
2018	1
2019	1
2020	1
2021	0
2022	0

Research methodology

The countries surveyed, populations, and data collection methods are presented in Table 2.4. The data were collected from eight countries; 18 out of 23 articles were published using data from the USA, followed by Canada with two articles. The data for the remaining articles were collected from Pakistan and Sweden, except for the study of Karimi et al. (2014), which was conducted in several countries including Iran, Malaysia, United Kingdom, and South Africa.

The population in this research is categorised into two general groups: students and others (e.g., users, voters, and employees). Most of the studies were conducted with users, voters, and employees, whereas very few studies had taken data from students. All the articles used a survey design, except Levy and Windahl (1984) and Gibbs et al. (2014), which used interviews and surveys together.

Table 2.4: Country of research, population, and data collection method for GO-GS research

Surveyed countries	#[a]	Selected Population [a]	Methodology [a]	References [a]
USA	18	Others[b]: 13 Students: 6	Survey: 18	(Bae, 2018; Barton, 2009, 2013; Dobos, 1992; Garramone, 1984; C. A. Lin, 1993; McLeod et al., 1982; Palmgreen et al., 1981, 1980; Palmgreen & Rayburn, 1979, 1985; Palomba, 2018; Rayburn et al., 1984; Rokito et al., 2019; Z. Wang & Tchernev, 2012; Wenner, 1982, 1986; Yoo, 2011)
Canada	2	Others: 1 Students: 1	Survey: 1 Interview & survey: 1	(Gibbs et al., 2014; Houghton-Larsen, 1982)
Pakistan	1	Others: 1	Survey: 1	(Hussain et al., 2020)
Sweden	1	Others: 1	Interview & survey: 1	(Levy & Windahl, 1984)
Iran, Malaysia, United Kingdom, South Africa	1	Students: 1	Survey: 1	(Karimi et al., 2014)

[a] It exceeds the actual number because researchers have collected data from more than one country and population; [b] Others mean users, voters and employees.

2.3.1.2 Discussion and suggestions for future research

This sub-section is based on the systematic literature review (Paul & Benito, 2018; Shahab et al., 2021), which discusses the reviewed articles to develop a future research agenda. Five main realms can be identified that are grounded in the literature developments: (i) research context, (ii) regions of research, (iii) media, (iv) gratifications, and (v) consumer behaviour.

Research context

These 23 articles overwhelmingly contributed to the literature of communication (see Table 2.5), such as gratifications sought from different television programmes and gratifications obtained from them (Barton, 2009, 2013; Palmgreen et al., 1980, 1981; Wenner, 1982, 1986), differences in GS and GO based on different demographics, and personality traits (Houghton-Larsen, 1982; Hussain et al., 2020; Karimi et al., 2014; Palmgreen & Rayburn, 1979; Rayburn et al., 1984), and role of the media on user's behavioural intention, satisfaction, recursive usage, and exposure (Bae, 2018; Levy & Windahl, 1984; C. A. Lin, 1993; Palmgreen & Rayburn, 1985; Rokito et al., 2019; Wang & Tchernev, 2012; Yoo, 2011). Contrary, few articles focused on the different research contexts, for example, human resource management (Dobos, 1992), political science (Garramone, 1984; McLeod et al., 1982), sports, i.e., football (Gibbs et al., 2014) and video games (Palomba, 2018). At the same time, other research contexts are overlooked by the researchers, including education, entrepreneurship, environment, health, marketing, public administration, and tourism.

Palmgreen and Rayburn (1979) first reported the issue in U&G theory and provided a clear concept of GS and GO. They compared GS with GO and provided several future directions. Palmgreen et al. (1980) extended the work of Palmgreen and Rayburn (1979).

The researchers came to three significant conclusions about the relationship between the gratifications people seek from television news and the gratifications they obtained. First, GS is related to the corresponding GO. Second, viewers who watch multiple programmes get fulfilment from a wider range of sources; thus, any single programme would be insufficient to provide all TV news-related gratifications. Third, GS and GO are completely different from each other. The researchers still follow these suggestions.

Palmgreen et al. (1981) researched three network news programmes and concluded that GO measures have more predictive power in a discrepancy model. They also argued that *"much work remains to be done in illuminating the nature of the relationship between gratifications sought and obtained, the antecedents of such gratifications, and the ways in which such gratifications are related to media behavior"* (p. 476). Wenner (1982) replicated the studies of Palmgreen et al. (1980, 1981) and compared a transactional model and discrepancy models of gratifications to predict exposure to and dependency on 60 Minutes news programmes and network evening programmes. He concluded that the discrepancy models developed by Palmgreen et al. (1980, 1981) showed better results in studying the role of gratifications sought and obtained in media effects.

McLeod et al. (1982) compared the drive-reduction and exposure-learning models. The drive-reduction model measures the degree of fit between each GS and GO provided by the media source. Exposure-learning model is less rational; media use is a habitual activity rather than a planned search for specific content. The first drive-reduction model fulfilled nine of the 11 gratifications, whereas the second exposure-learning model received strong support for the other two gratifications. McLeod and colleagues concluded that it might not be advisable to force a choice between the two motivational models. Each may be applicable under certain conditions and for certain types of people. Garramone

(1984) replicated the study of McLeod et al. (1982) and found that the exposure learning model is better for explaining satisfaction with political news on TV.

Palmgreen and Rayburn (1985) compared six alternative gratification models and two transactional models to predict media satisfaction through hierarchical regression analysis. The models were: (1) gratifications obtained model ∑(GO); (2) modified gratifications obtained model ∑ e(GO); (3) expectancy-value model ∑(be); (4) absolute value discrepancy model ∑ |GS - GO|; (5) simplified discrepancy model ∑(GO - GS); (6) expectancy-value discrepancy model ∑ e(GO - GS); transactional models (7) ∑(GS+GO) and (8) ∑ e(GS+GO). Palmgreen and Rayburn (1985) found that *"introducing the respondent's affective evaluation of gratification-related attributes did not result in the consistent superiority of Model 2 (∑ eGO) and Model 6 [∑ e (GO-GS)] over their non-evaluative counterparts (Models 1 and 5, respectively)"* (p.343). They also reported that *"the absolute value model* (Model 4: ∑ |GS-GO|) *should not be employed in future research"* (p. 343) and expectancy-value model (Model 3: ∑be) yielded a low change in the coefficient of determinant (R^2). Out of the other models, Palmgreen and Rayburn (1985) suggested that the gratifications obtained model (model 1: ∑GO) and modified gratifications obtained model (model 2: ∑ eGO) were superior to other models.

Gibbs et al. (2014) conducted research on the Twitter followers of the Canadian Football League by using the GO-GS approach. They found that followers of professional sports teams want to satisfy four primary gratifications: promotion, interaction, news, and live game updates. Gibbs and colleagues studied satisfaction as a dependent variable by following the basic arguments of SERVQUAL and expectancy-value theory. Gibbs et al. (2014) were pioneers in studying Twitter followers from a team perspective, and they suggested exploring other leagues and teams as well. Palomba (2018) also used the GO-GS approach and provided literature support from expectancy-value theory to study emotions.

He explored the impact of a high brand loyalty video game on players' experience and regulating/repairing emotions. It was found that video game players with high brand loyalty perceived themselves to have high perceived emotional intelligence and were inclined to seek discernible gratifications from video gameplay. These players were aware of their feelings during video gameplay, and a video game fulfilled their gratifications.

Table 2.5: Research context studied with GO-GS approach

Research context	#	References
Role of the media on user's behavioural intention, satisfaction, recursive usage, and exposure	7	Bae (2018), Levy and Windahl (1984), C. A. Lin, (1993), Palmgreen and Rayburn (1985), Rokito et al. (2019), Z. Wang and Tchernev (2012), Yoo (2011)
Gratifications sought and obtained from different television programs	6	Barton (2009,2013), Palmgreen et al. (1980,1981), Wenner (1982,1986)
Differences in GS and GO are based on different demographics and personality traits	5	Houghton-Larsen (1982), Hussain et al. (2020), Karimi et al. (2014), Palmgreen and Rayburn (1979), Rayburn et al. (1984)
Role of the different media for voting	2	Garramone (1984), McLeod et al. (1982)
Employee's satisfaction from different media: electronic media, written memos, and face to face conversation	1	Dobos (1992)
Satisfaction from the media to get updates on football	1	Gibbs et al. (2014)
Media consumption experience from the video game	1	Palomba (2018)

Above mentioned researchers used the GO-GS approach along with other models. Contrary, most researchers solely used the GO-GS approach by using gratifications discrepancy scores as independent variables (see Table 2.7). Despite the suggestion provided by Palmgreen and Rayburn (1985), researchers are still using the GO-GS approach (Bae, 2018; Palomba, 2018). Therefore, due to scant research in this context, there is a need to compare different models using strong statistical analysis, including structural equation modelling (SEM). The literature also lacks a comparison of models

dealing with the gratifications sought and the user's personal importance. Hence, this research compares seven models to propose one best model for future research.

Regions of research

North America was the most surveyed region with 20 out of the 23 identified articles, whereas two articles were published from Europe and Asia. Karimi et al. (2014) took their data from Asia, Europe, and Africa. Therefore, the regions of Oceania and South America have been overlooked by researchers. Additionally, other countries with strong research contributions have not published any research article using GO-GS approach, such as China (2nd highest contributor), Germany (3rd), Japan (5th), France (6th), Switzerland (8th), South Korea (9th) and Australia (10th; Crew, 2019). Therefore, there is a need to conduct research on the GO-GS approach in these countries to understand user behaviour better.

Types of Media

The reviewed articles have made breakthrough contributions by studying the impact of diverse communication media on users. For example, television, printed media, social media, computer-related media, radio, mobile phones, phonographs, and face-to-face conversations have been studied (see Table 2.6). Scholars have under-researched new technologies such as AR, chatbots, location-based services (LBS), smartphone applications, smart watches, and VR. Therefore, a research gap exists in studying the GO-GS approach with new technologies.

Table 2.6: Communication medium in the identified studies

General Category	Sub-Category	#[a]	References [a]
Television	• Reality programs: The Apprentice, The Bachelor, Survivor, American Idol, Dancing with the Stars, America's Got Talent • News programs: World News Tonight, evening news, nightly news, network evening news, 60 minutes • General news • Advertisements	15	Barton (2009, 2013), Garramone (1984), Houghton-Larsen (1982), Levy and Windahl (1984), Lin (1993), McLeod et al. (1982), Palmgreen et al. (1981, 1980), Palmgreen and Rayburn (1979, 1985), Rayburn et al. (1984), Z. Wang and Tchernev (2012), Wenner (1982, 1986)
Social media	• Social networking sites, • Facebook • Twitter	5	Bae (2018), Gibbs et al. (2014), Hussain et al. (2020), Karimi et al. (2014), Rokito et al. (2019)
Printed media	• Newspaper • Magazines • Books • Written memos	5	Dobos (1992), Garramone (1984), Houghton-Larsen (1982), McLeod et al. (1982), Z. Wang and Tchernev (2012)
Computer-related mediums	• Video games • Online newspaper • Electronic media	4	Dobos (1992), Palomba (2018), Z. Wang and Tchernev (2012), Yoo (2011)
Radio	• N/A	2	Houghton-Larsen (1982), Z. Wang and Tchernev (2012)
Mobile phones	• N/A	1	Z. Wang and Tchernev (2012)
Phonographs	• N/A	1	Houghton-Larsen (1982)
Face-to-face conversation	• N/A	1	Dobos (1992)

[a] It exceeds the actual number because several articles had used more than one media

N/A: Not applicable

Gratifications

Table 2.7 presents the diverse gratifications studied by the researchers according to the nature of the communication medium. For example, social media provides socialisation; hence, Bae (2018) studied "social support" gratification. In the same way, "information seeking" has been widely studied in the context of television and "seeking fantasy" with video games; other gratifications are given in Table 2.7. Sundar and Limperos (2013) extended the usage of U&G theory by proposing its 2.0 version for new technologies, "*noting that studies on the uses of the Internet have generated a list of gratifications that are remarkably similar to those obtained from older*

media…gratifications are conceptualized and operationalized too broadly (e.g., information-seeking), thus missing the nuanced gratifications obtained from newer media" (p. 504). U&G theory 2.0 version provides variables for measuring gratifications such as novelty, being there (telepresence), realism, dynamic control, coolness, agency enhancement, community-building, interaction, activity, responsiveness, browsing, and navigation aids (Sundar & Limperos, 2013).

In order to provide a rigorous future research agenda, "uses and gratifications" key terms were also searched in google scholar to obtain articles published using U&G theory. Table 2.7 explicitly presents the gratifications studied using the GO-GS approach. Additionally, Table 2.1 provides an extensive list of the gratifications and media studied in the literature using U&G theory. By comparing these two tables, a triangle figure is developed (see figure 2.1) to summarise the contributions of the GO-GS approach in the extant literature and future research agenda for GO-GS. Several new gratifications are proposed that should be studied with new media elements. For example novelty, realism, coolness, activity, responsiveness, achievement, challenge, and telepresence.

Table 2.7: Other theories/models, gratifications and outcomes studied with the GO-GS approach

References	Other theories or models	Gratifications/independent variables	Dependent Variable(s)	Results
Bae (2018)	-	Information, entertainment, escapism, social support, convenience, socialization	Satisfaction, continuance intention	Entertainment, social support and socialization GO-GS discrepancies showed significant impacts on users' satisfaction, and satisfaction leads to continuance intention
Barton (2009)	-	Personal utility, social utility, pass time, perceived reality, vicarious participation	*Groupings based on three programs*	Competition-based reality programs fulfilled all gratifications. But specific programs fulfilled specific gratifications in a better way. For example, *The Bachelor/Bachelorette* program showed romantic elements that fulfilled social utility and *Survivor* program showed realistic competition that fulfilled perceived reality
Barton (2013)	-	Schadenfreude, personal utility, social utility, TV personalities, vicarious participation, perceived reality, pass time	*Groupings based on three programs*	Barton identified two new gratifications for watching talent-based reality shows: TV personalities and Schadenfreude (people like to see poor performance and foolishness of others). The talent-based reality shows fulfilled all gratifications. The results were aligned with the previous research of Barton (2009)
Dobos (1992)	-	Production, maintenance, and innovation	Satisfaction and channel choice	Different media satisfied different gratifications
Garramone (1984)	Drive reduction model, Exposure learning model	Surveillance-vote guidance	*Groupings based on three media*	The exposure learning model was better for explaining satisfaction with political news on TV
Gibbs et al. (2014)	Expectancy value theory, SERVQUAL	Interaction, promotion, live game updates, news	Satisfaction	Twitter satisfied users' gratifications of interaction, promotion, live game updates, news

References	Other theories or models	Gratifications/independent variables	Dependent Variable(s)	Results
Houghton-Larsen (1982)	-	Relaxation, entertainment, information, companionship, forget loneliness, enjoyment, excitement, local information, information on international events, detailed information on national events, information on movies, detailed information on international event and weather, time, music	*Analysis based on gender, income, watching habits, and age brackets*	Houghton-Larsen studied several gratifications for six different media. He also found that every media is useful in fulfilling specific gratifications. For instance, the radio provided latest information, weather reports, time and music. TV provided entertainment, companionship, excitement and to forget loneliness
Hussain et al. (2020)	-	Cognitive	*Groupings based on gender and profession*	Information professionals used social media for cognitive needs, but GO differed from GS. Hence, information professionals must revisit their needs for using social media
Karimi et al. (2014)	-	Interpersonal utility, pass time, entertainment, information seeking, convenience	*Groupings based on different countries*	Karimi and colleagues investigated how social networking sites (SNS) fulfilled users' needs from different cultures. Iranian users primarily preferred to *seek information*, Malaysian users preferred *interpersonal utility,* United Kingdom users highlighted *convenience* motivation, and South African users reported *pass time.* SNS also fulfilled other gratifications
Levy and Windahl (1984)	-	Entertainment-parasocial interaction, interpersonal utility, surveillance	Inattentive behaviour, exposure	TV news programs fulfilled all gratifications
C. A. Lin (1993)	-	Informational guidance, interpersonal communication, parasocial interaction, entertainment, diversion	Viewing satisfaction	Viewers satisfied their gratifications by watching TV. Lin also reported that strongly motivated viewers showed active engagement in various audience activities and received greater viewing satisfaction

References	Other theories or models	Gratifications/independent variables	Dependent Variable(s)	Results
McLeod et al. (1982)	Drive reduction model, Exposure learning model	Surveillance-vote guidance, contest-excitement, communication utility	*Groupings based on age and time of decision*	The media fulfilled all gratifications. McLeoad and colleagues found that under certain conditions and for certain types of people, each model may be applicable
Palmgreen and Rayburn (1979)	-	Relaxation, learning about things, communicatory utility, to forget, to pass time, companionship, entertainment	*Analysis based on viewers vs non-viewers, education, income, number of children, number of TV sets, perceptions of public television*	Palmgreen and Rayburn reported the issue in U&G theory and provided a clear concept of GS and GO. They compared GS with GO and provided several future directions
Palmgreen et al. (1980)	-	General information seeking, decisional utility, entertainment, interpersonal utility, parasocial interaction	*Groupings based on three programs*	The researchers came to three significant conclusions about the relationship between the gratifications people seek from television news and the gratifications they report obtaining. First, GS is related to the corresponding GO. Second, viewers who watch multiple programs get fulfilment from a wider range of sources. Thus, any single program would be insufficient to provide all TV news-related gratifications. Third, GS and GO are completely different from each other. The researchers still use these contributions in the literature
Palmgreen et al. (1981)	-	General information seeking, decisional utility, entertainment, interpersonal utility, parasocial interaction	*Analysis based on discrepancies between the programs, viewership, interest in politics, discussion on politics, radio news exposure, newspaper readership, family income, age, education*	They concluded that GO measures have more predictive power in a discrepancy model

References	Other theories or models	Gratifications/independent variables	Dependent Variable(s)	Results
Palmgreen and Rayburn (1985)	Gratifications obtained model, Modified gratifications obtained model, Expectancy value model, Absolute value discrepancy model, Simplified discrepancy model, Expectancy value discrepancy model	General information seeking, decisional utility, entertainment, interpersonal utility, parasocial interaction	Media Satisfaction	They compared six alternative gratification models and two transactional models to predict media satisfaction through hierarchical regression analysis. Out of the other models, Palmgreen and Rayburn (1985) suggested that the gratifications obtained model (model 1: ∑GO) and modified gratifications obtained model (model 2: ∑ eGO) were superior to other models
Palomba (2018)	Expectancy value model	Seeking fantasy, seeking information & reflection, positive virtual engagement, virtual distractions	Media consumption experience, gratifications obtained	Video game players with high brand loyalty perceived themselves to have high perceived emotional intelligence and were inclined to seek discernible gratifications from video gameplay. These players were aware of their feelings during video gameplay, and a video game fulfilled their gratifications
Rayburn et al. (1984)	-	General information seeking, decisional utility, entertainment, interpersonal utility, parasocial interaction, current affairs	*Analysis based on anchor-persons discrepancies, program style discrepancy, program quality discrepancy, GO-GS discrepancy, education, income*	Rayburn and colleagues endorsed the results of Palmgreen et al. (1980, 1981)

References	Other theories or models	Gratifications/independent variables	Dependent Variable(s)	Results
Rokito et al. (2019)	-	Social information, pastime, sociability, self-relief, self-affirmation	Recursive Facebook use	More than half of the users reported that GO from Facebook was less than GS. Over-gratifications and a strong habit of using Facebook resulted in an increasing number of times per day people visited Facebook and lengthy sessions
Z. Wang and Tchernev (2012)	-	Emotional, cognitive, social, habitual	Multi-tasking behaviour	Media multitasking did not satisfy cognitive needs, whereas emotional gratifications were obtained despite not being actively sought. The media fulfilled other gratifications
Wenner (1982)	-	Surveillance, entertainment, interpersonal utility, parasocial interaction	*Analysis based on GO-GS discrepancies, obtained gratifications from two programs, dependency, attention, habit, education, income, age, gender*	Wenner replicated the studies of Palmgreen et al. (1980, 1981)
Wenner (1986)	Transactional model	Surveillance, entertainment, interpersonal utility, parasocial interaction	Frequency of viewing and dependency on programs	The media fulfilled all gratifications. The transactional model was more effective in studying dependency, whereas the discrepancy model was more effective in predicting the frequency of viewing
Yoo (2011)	-	Socialization, entertainment, information seeking, pastime	Attitude toward the online newspaper, repeat visit intention	Online newspapers fulfilled all gratifications. Audience interactivity mediated the relationship between gratifications and attitude toward the online newspaper and repeat visit intention

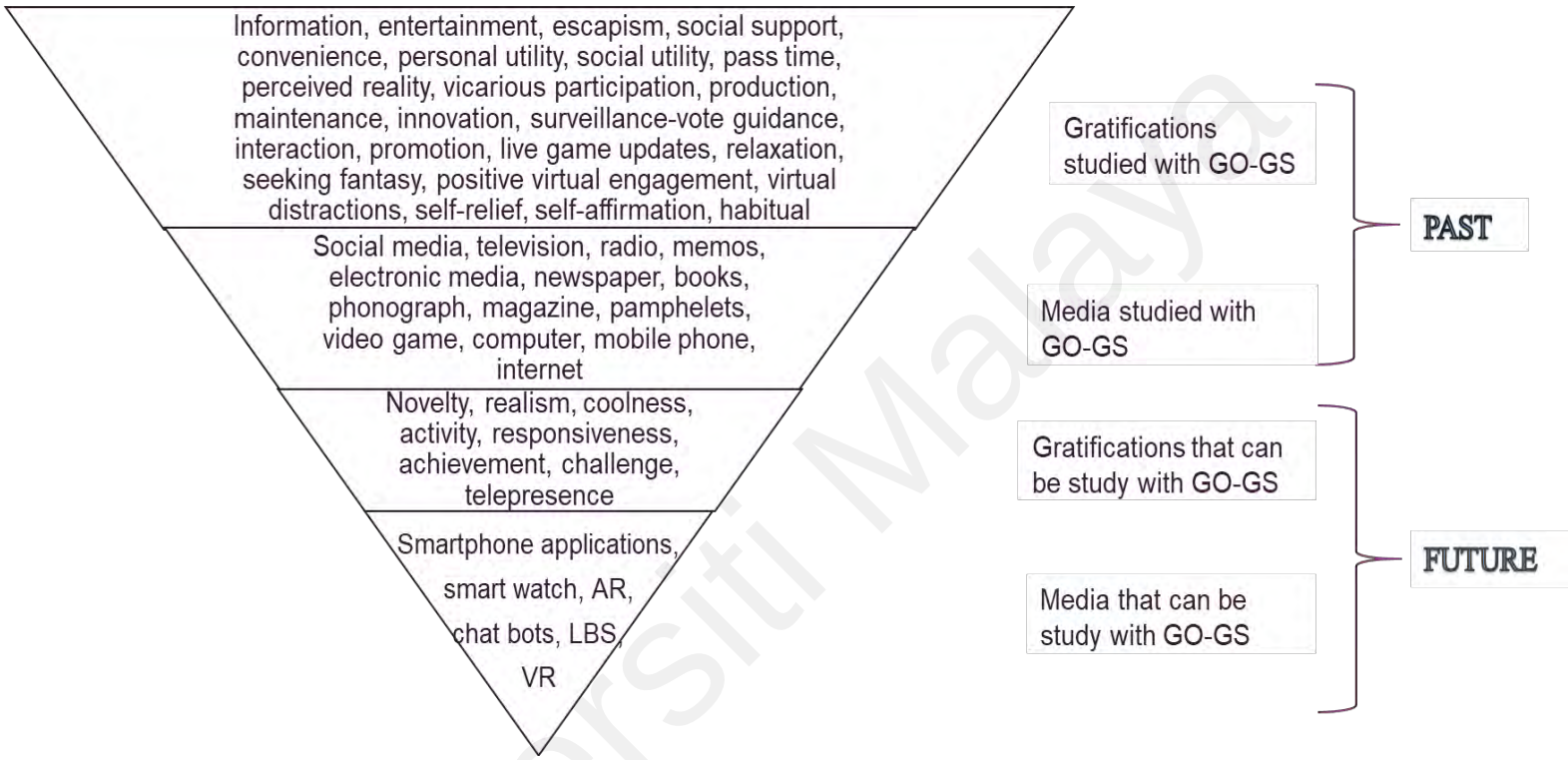

Figure 2.1: Gratifications and media for future research in the context of GO-GS research

In this sub-section, only those gratifications are discussed that can be studied with new media in the future. *Novelty* is defined as a situation that has not been previously encountered or experienced by a person (Barto et al., 2013). Sundar and Limperos (2013) explained novelty as an unusual new technology experience with a different interface. Empirically studying novelty gratification may enhance the U&G theory by deepening the understanding of users' nuanced gratifications. *Realism* is a user's perception of reality in which visual-related stimuli generate a sense of a more realistic virtual environment than non-visual forms (Meijer et al., 2009). For example, video conference is considered more realistic than an audio conference or text (Sundar & Limperos, 2013). *Coolness* relates to a user's perceptions of liking and approving new ideas, services, or products, which are generally positive (Kerner & Pressman, 2007). Individuals prefer to use new technology that makes them look cool (Liu & Mattila, 2019) and that is also unique, distinctive, and stylish (Sundar & Limperos, 2013). *Activity* is a user's active interaction with technology, through which a user can perform many tasks (Sundar & Limperos, 2013). The perfect example of this gratification is the AR Pokémon GO game in which users actively participate in catching the Pokémon.

Responsiveness is a technological characteristic that enables users to quickly respond to the technology to fulfil their need for active interaction (Sundar & Limperos, 2013). *Achievement and challenge* are gratifications that are recently studied with the AR Pokémon GO game (Ghazali et al., 2019a). Still, there exists a gap in the literature to study these gratifications using the GO-GS approach. Specifically, achievement is a user's motivation to advance rapidly and attain an important goal. It can be applied to achieving knowledge, a promising career, or success in video games (Salvador & Carmen, 2001; Wu et al., 2010). Conversely, the challenge is the gratification that is studied in the context of

video games, and Liu and Shiue (2014) defined it as "*the overcoming of perceived difficulties, including competition from other players…which provides a sense of accomplishment*" (p. 127).

Sundar and Limperos (2013) explained "being there" as the immersive feeling of being in a 360-degree interactive panoramic view shown through the technology. In the literature of new technologies, the phenomenon of being there is mainly referred to as *telepresence*. Specifically, telepresence is the characteristic of a technology replicating a real scenario in a computer-mediated environment, with users being deeply involved in that environment (Suh & Chang, 2006). The gratifications mentioned above can be adopted in different scenarios; novelty, realism, coolness, activity, responsiveness, and telepresence are suitable for tourism-related multi-sensory VR.

Outcomes

Table 2.7 demonstrates that some articles have explored consumer-related factors, such as attitude, intention, or behaviour (Bae, 2018; Levy & Windahl, 1984; Rokito et al., 2019; Z. Wang & Tchernev, 2012; Yoo, 2011), and satisfaction (Bae, 2018; Dobos, 1992; Gibbs et al., 2014; C.A. Lin, 1993; Palmgreen & Rayburn, 1985). Thus, neglecting the study of pleasantness of experience, reuse intention, purchase intention, loyalty, and decision-making.

Pleasantness of experience is a collection of positive and negative emotions. It deals with the outcomes of a product or service, for example, happy or unhappy, satisfied or unsatisfied, pleased or annoyed, relaxed or bored, and others (Van Kerrebroeck et al., 2017a). From the theoretical perspective, roots of pleasantness of experience can be traced back from the hedonic theory, also known as the theory of psychological hedonism. It posits that human behaviour is driven by the pursuit of pleasure and the avoidance of pain

or displeasure. It received prominence within the field of psychology, behavioural sciences, and neurology (Angelino et al., 2021; Horng & Hsu, 2021). Pleasantness of experience is crucial in the context of immersive media because it directly affects the user's level of engagement. VR creates a sense of presence and transports users to new worlds. However, users can detract from the overall immersive experience if they feel discomfort, such as unpleasant sensory experiences, discomfort from wearing VR headset, or motion sickness. Therefore, studying pleasantness of experience is essential to understand user behaviour.

Reuse intention deals with the visitors' intention to reuse multi-sensory VR at tourism destinations, considering its emergence from interviews and the significance of related intentions in VR tourism literature. Contrary, purchase intention is visitors' willingness to buy VR for personal use. Literature has explored purchase intention in various VR and tourism contexts, but the purchase intention of VR itself has been overlooked.

2.3.1.3 Conclusion of SLR of GO-GS discrepancies approach

Several research gaps are proposed after analysing the GO-GS literature. The researchers studied the GO-GS approach with several communication mediums by using diverse gratifications such as information seeking, entertainment, escapism, social utility, promotion, surveillance-vote guidance, and others. Academic literature lacks investigation of the GO-GS approach with new media and research on nuanced gratifications, for example, novelty, realism, coolness, activity, responsiveness, achievement, challenge, and telepresence. This research proposes five realms that can be envisioned as grounded on the literature developments, including research context, regions of research, media, gratifications, and consumer behaviour.

2.4 Virtual Reality

VR has a long history of its development. Sir Charles Wheatstone first described it as stereopsis in 1838 (Barnard, 2019). In the mid-1980s, it had different names like cyberspace, synthetic environment, simulator technology, artificial reality, and got its final name 'VR' (Onyesolu & Eze, 2011). Sir Charles Wheatstone introduced it as a binocular vision of two different images: the right eye watches an impression on the right side, and the left eye watches the left image, which provides a more immersive and in-depth image. After almost a century, an American story writer in 1935 described the future of VR in his fictional short film by showing a professor who has invented a pair of goggles that can provide sight, hearing, taste, touch, and feeling of smell (Barnard, 2019). In 1956, Morton Heilig, an American cinematographer, first created VR machines patented in 1962. This machine provided 3D coloured video, smell, audio, vibrations, and different environmental effects like the wind. The initial idea was to use it as the "cinema of the future" by providing a fully immersive environment to users.

By the end of the 1980s, the application of VR was extended to other fields like military, flight, and transportation activities (Barnard, 2019). In 1982, the first gesture recognition gloves (Sayre gloves) were manufactured by Sandin and Defanti, which were wired gloves and were able to convert finger actions into electric signals. The training element of VR was taken to a higher level when Furness and British Aerospace developed a super cockpit known as a VR flight simulator. It was able to train pilots by providing real-time data, such as a conversation with radar, advanced infrared, and 3D maps. The first application of VR in video games was launched with the name "Virtuality" in 1991 by using VR arcade machines. Gamers could compete with other players in multiplayer mode via a networking approach. The late 1990s belonged to the use of VR in games when

organisations like SEGA and Nintendo launched their VR gaming headsets (Barnard, 2019).

In the early years of the 21st century, its latest manifest was desktop VR, also known as non-immersive VR or window on the world (WoW) (Onyesolu, 2006). This desktop VR played a significant role in promoting the technology by providing a VR experience that was not fully immersive, requiring less technological expertise, and most importantly, it was cheap. Because of these positive aspects, organisations wholeheartedly accepted it as a tool to train and develop employees. After achieving success in training and development programmes, VR content creators introduced a more immersive and general creation that was initially adopted for educating the students and it was termed as VLE-virtual learning environment (van Raaij & Schepers, 2008). VLE was capable enough to provide learning and teaching opportunities to facilitate the practice of engineering (Callaghan et al., 2009), medicine (J. Lu et al., 2005), and other higher education (Koskela et al., 2005). Thus, virtual learning environments emerged as one of the mainstream teaching methods to enhance the productivity of traditional teaching systems in schools and universities. It is also empirically proven that the VLE method is more effective than the traditional teaching method (Moazami et al., 2014) because it provides three-dimensional (3D) details of any system, structure, or human body to replicate reality with an artificial computer environment. Ultimately, helping the students to freely, pleasurably, and effectively navigate a system without fear of any loss or damage (Ausburn & Ausburn, 2004; Onyesolu, 2009a, 2009b). The same is mentioned by Jewitt (2018):

> *"Entering the virtual world, learners can adopt a role to practice their skills via role-play activities, before transferring their skills to real life, prior to being assessed. Anonymity enables learners to build their*

confidence, make numerous attempts, develop and practise skills, take risks, fail and communicate more than they may in a real-life situation. There's no fear of asking a stupid question or saying the wrong thing, instead students can grow and develop in a safe environment. Virtual worlds have limitless possibilities in education" (p.326).

The usage of VR in health-related fields was appreciated by scientists in 2014. The Nobel Prize winners in "Physiology or Medicine" field mentioned the usage of VR for their research in discovering the nerve cells that facilitate a sense of navigation and place (Minderer et al., 2016). Three other scientists won the Nobel Prize in "Physiology or Medicine" for their discoveries of molecular mechanisms that control the circadian rhythm. OneReality Company developed a VR-"The Cell-Circadian Rhythm" to show the discovery of molecular mechanisms in which users can imagine themselves *"inside a cell and watching how the biological clock operates… understanding more about how the biological clock ticks may lead to treatments for obesity, sleep disorders, mental health disorders and other health problems… you then continue on your journey through the human body. You are shown not only how humans, but how plants and animals adapt to the biological rythms of the Earth's rotations"* (Reeder, 2017).

VR was used in training and development during the initial developmental era of VR, which is a field of social sciences. VR also gained success with the passage of time in other fields of social sciences like marketing, tourism, psychology, and fine arts. The use of VR in marketing was initially proposed by Pennington (2001):

"Interactivity provides marketers with the means to deliver virtual realities custom designed for and by each consumer. With the help of computer-assisted marketing, consumers can form virtual societies and

cultures. Consumers can be the architects of their virtual realities by selecting attributes" (p.33).

Nowadays, VR is one of the main marketing tools for many organisations, for example, Viking City Waterford, Etihad Airways, Thomas Cook, Legoland Florida, Disney, New York Times, Europa Park, Marriot Hotel, The Louvre Museum Virtual Tour, British Museum and Australian VR Tour (Be there, 2017; Bevil, 2018; S. Hudson et al., 2019; Mbryonic, 2019). The proposed usage of VR in tourism was presented in 1995 by two researchers Hobson and Williams (1995) and Williams and Hobson (1995). Therefore, the applications of VR in tourism are also evident from an academic and managerial perspective (Tussyadiah et al., 2018). Hoffman (1998) proposed the usage of VR in Psychology, and Psychologists appreciated this idea by conducting research in this context (Pan & Hamilton, 2018; Quesnel & Riecke, 2018). Contrary, VR has a long-standing in fine arts since 1956, but its success can be seen in 2015 when Malicki-Sanchez organised the first VR film festival in Canada (Silverberg, 2015).

VR has attracted the interest of scholars for decades (Cheong, 1995; Hobson & Williams, 1995; S. C. H. Li et al., 2017). In the mid-1990s, Cheong (1995) depicted a virtual tour using a VR device. He stated that VR is a revolutionary approach through which users can immerse themselves in VR content. VR experiences can also provide customers with detailed product information (Lee & Chung, 2008), which will address the consumers' complaints of interaction with the products (Suh & Chang, 2006). VR can simulate the tourism experience. It can generate a compelling sense of telepresence (Suh & Chang, 2006). Applications of VR in tourism attracted great attention from both scholars and practitioners (Guttentag, 2010; Martins et al., 2017).

Several studies have shown that VR has a good capacity to stimulate tourists' travel intention compared with traditional marketing tools (Y. C. Huang et al., 2013; Hwang et al., 2012; Spielmann & Mantonakis, 2018). For example, Spielmann and Mantonakis (2018) through experimentation found that a virtual tour could affect tourists' attitudes toward an advertising object. Hwang et al. (2012) used a VR restaurant to study the effect of crowding on customers' psychology and behaviour. In another study, Y.C. Huang et al. (2013) found that tourists' positive emotions, emotional involvement, and flow were positively related to their travel intention.

This sub-section highlighted the history of VR and its usage in several areas such as entertainment, military, flight simulation, transportation, games, training and development, education, health-related fields, marketing, tourism, psychology, and fine arts. The succeeding sub-section discusses the components that are needed to experience VR content.

2.5 Components of VR

The components required to use VR are divided into two main categories, i.e., hardware and software. These two components have a long-standing among human-computer interaction (HCI) technologies, such as computers, mobile phones, smart-tablet, VR, AR, and smartwatches, etc.

2.5.1 Hardware

The hardware components are physical parts of VR, which are further divided into four subcategories: sensory display, computer workstation, input devices, and tracking system.

2.5.1.1 Sensory display

The sensory display is the most important component of VR as it provides visual and audio content. Modern VR headsets can provide ultra-high-definition vision and sound by sensing the movement of a head in the 360-degree dimension that perfectly blends real movement with the computerised environment (Wheeler, 2016). These innovative sensory displays are known as head-mounted displays (HMD). HMD provides a display through the screen to each eye. The change of scene and orientation of VR content is controlled by the sensors affixed to the helmet that senses the movement of the head and provides a real-time new perspective of VR film. Head-mounted displays like HTC Vive and Facebook's Oculus Rift provide ultra-high-definition immersive VR content and have earphones to engage both audio-visual senses. Some of the less costly VR headsets are also available in the market, like Samsung Gear VR that works by inserting a mobile phone into the VR box, and the mobile phone provides sound through its speakers. The cheapest VR headset is Google Cardboard which also works through a smartphone (Mehrfard et al., 2019; Wheeler, 2016). The visual depiction of VR headsets is given in figure 2.2.

2.5.1.2 Computer workstation

Vive and Oculus need to be connected to high-performance computer workstations to provide a VR experience. Zhong et al. (2017) mentioned that *"all existing high-quality virtual reality (VR) systems (e.g., HTC Vive and Oculus Rift) are tethered, requiring an HDMI cable to connect the head mounted display (HMD) to a PC for rendering rich graphic contents"* (p.1). Headsets that are connected to computer workstations are known as 'tethered-VR'. The different VR contents can be selected and played via a computer workstation. These workstations should be equipped with performance 3D graphics and

sound cards. Some researchers consider these process acceleration cards as the fifth most important hardware (Onyesolu & Eze, 2011).

On the other hand, Samsung Gear VR and Google Cardboard do not require a workstation, and they can be used conveniently by inserting smartphones into them. These headsets are known as 'mobile-VR'. Mobile-VR is less immersive as compared to tethered-VR.

a: HTC VIVE

b: Facebook Oculus

c: Samsung Gear

d: Google Cardboard

Figure 2.2: VR headsets

2.5.1.3 Input devices

Devices that can help in interaction with the virtual environment are known as input devices, such as a joystick, voice recognition, keyboard, instrumented glove, and others (Onyesolu & Eze, 2011). These input devices depend on VR headsets. For instance, some highly immersive and interactive headsets work with a joystick that provides different options for interacting with VR content (e.g., Vive & Oculus). Some VR headsets

do not require a joystick-like Samsung Gear Google Cardboard and VR PlayStation (Ventuz, 2020). VR joysticks given in figure 2.3 have several buttons to perform functions in a virtual environment, such as teleporting at different locations, grabbing or equipping the objects, rotating left or right, and returning to the home screen.

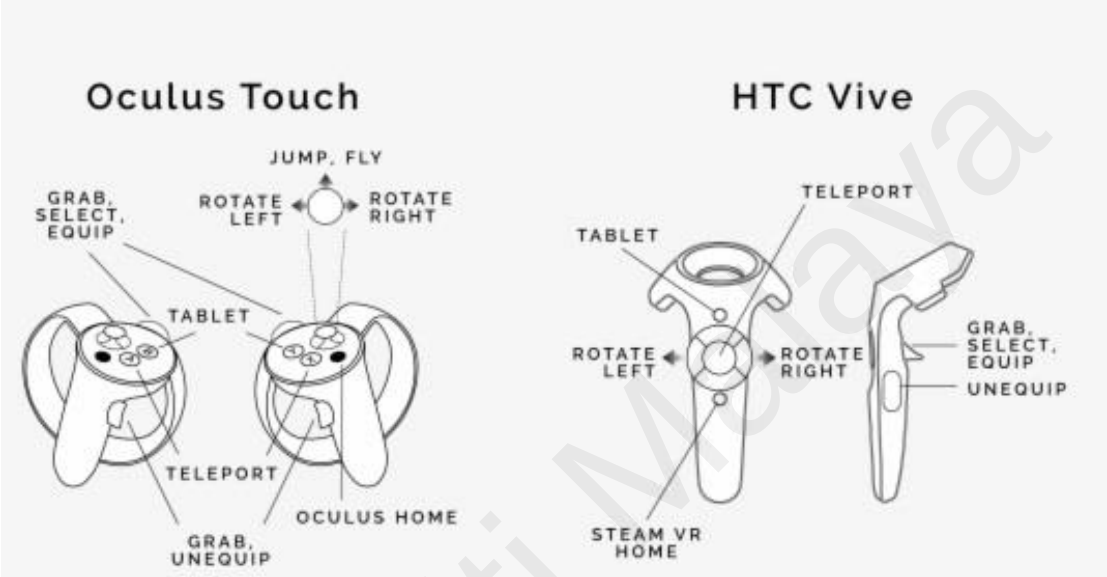

Figure 2.3: VR joysticks

Other input devices such as keyboards and instrumented gloves become obsolete with the wide availability of VR joysticks. Voice recognition is under trial nowadays, and it will take over the joysticks in the future. As Sami Heinonen, the project manager of ZOAN, mentioned that *"we want to remove the barriers for natural interaction and start using voice and touch, the most natural interfaces for humans in our solutions"* (Speechly, 2021).

2.5.1.4 Tracking system

Tracking system devices have an important role in providing an authentic feel of the virtual environment by tracking the orientation and position of a user. These devices replicate the original orientation and position of a user in a virtual environment (Caserman

et al., 2019). For example, sensing the movement of walking towards and against the objects. These devices use electromagnetic, infrared, mechanical, or ultrasound trackers (Onyesolu et al., 2012).

Mobile-VR can only provide three degrees of freedom (3DoF) that is also known as rotational motion. The users can only look down or up, to either side or tilt their heads. The users' body movement cannot be tracked in 3DoF, which is not suitable for content that needs physical interaction through hands or walking because it is limited to rotation only (Heaney, 2019). The six degrees of freedom (6DoF) allow rotational and transversal motions, which allow users to see up and down, freely move left and right or backward and forward, roll (longitudinal axis), yaw (normal axis) and pitch (transverse axis) (Google, 2019). In the 6DoF virtual environment, users can walk, use their hands to interact with the virtual objects, and move freely in all directions (see figure 2.4). The tethered-VR can provide 6DoF movement in a virtual environment (Heaney, 2019).

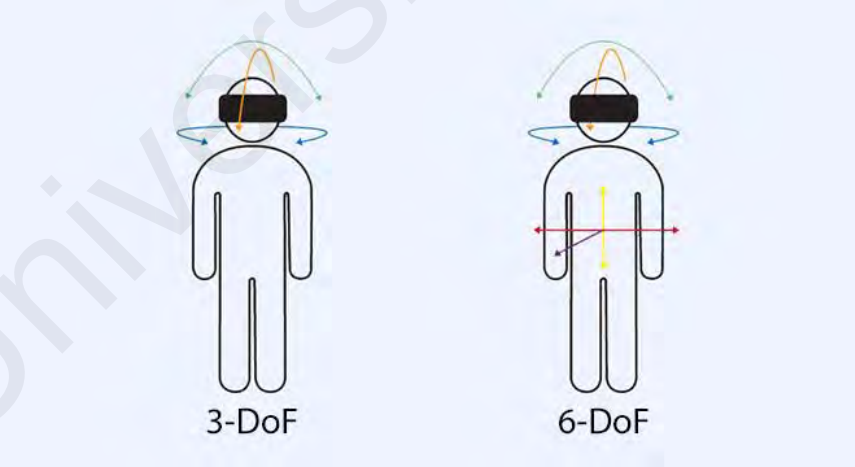

Figure 2.4: 3-DoF vs 6-DoF

2.5.2 Software

VR simulation software is an essential part of VR that manages everything with the help of other software like 3D modelling software and graphics software (Onyesolu & Eze,

2011). Kolor Eyes, Codeplex VR player, Vive, and LiveViewRift are examples of VR simulation software. One of these software is installed in computer workstations for Vive and Oculus devices. On the other hand, smartphones manage everything through Samsung Gear VR or Google Cardboard.

This sub-section discussed the components needed to experience VR content, such as hardware (sensory display, computer workstation, input devices, and tracking system) and software. The subsequent sub-section explains the role of VR in tourism.

2.6 Virtual Reality & Tourism

The VR capacity to be used in the tourism context was initially proposed by Hobson and Williams and Williams and Hobson in 1995:

> *"VR technology is essentially designed to create simulated versions of actual experiences, which are in fact so realistic that it is possible to believe you are engaged in the real one. Whether it is driving a tank in a World War 1 battle, visiting a museum, walking through a rain forest or lazing by the pool, there are potentially an infinite number of alternative tourism experiences which VR participants will be able to enjoy"* (Hobson & Williams, 1995, p.125).

On the basis of their recommendations, several VR contents were introduced from 1995 to 2010, e.g., exploring the rainforest virtually, visiting Washington Monument virtually, dancing in Ibiza, virtual guided tours (Burdea & Coiffet, 2003; Guttentag, 2010), and Dresden museum converted their master picture gallery into a virtual tour (L. E. Schmidt, 2014). Another scholar, Guttentag (2010) proposed several new dimensions due to the advancement of technology, which resulted in the use of VR in several tourism fields, such as hotels, theme parks, museums, airlines, and tourism related adventurous

activities (Chandler, 2020). VR nowadays is so modernised that it can show real content rather than only animated content (e.g., Travel to Dubai).

Virtual reality has an extensive contribution to the tourism field (D. Kim & Ko, 2019). It provides an integrative and interactive computer-generated environment that perfectly blends the real and unreal situations to enhance the simulated experience (P. Williams & Hobson, 1995). During the VR experience, tourists can touch, walk, see, and hear real-life images, making them feel that they are experiencing a real environment (Flavián et al., 2019; P. Williams & Hobson, 1995). This computer-generated 3D environment is also known as a virtual environment in which a user can navigate and interact with more than one sense (Burdea & Coiffet, 2003). It is important to provide a real-life experience because VR can enhance tourists' entertainment, education, heritage preservation, and tourism marketing (Guttentag, 2010). Over time, it has been noticed that VR can address these propositions by providing an entertaining experience (W. Wei et al., 2019), heritage preservation (Aziz & Siang, 2014), and tourism marketing (Griffin et al., 2017). All propositions are well-tested except for the change in knowledge after using VR in the context of tourism. Hence, an extensive search of the literature is conducted to better understand the development in tourism literature because of VR and to identify the potential research gaps.

SLR methodology and the prisma framework of VR in tourism literature are discussed in section 4.2.3.

2.6.1 Overview of research documents

2.6.1.1 Publication outlets

A total of 84 research documents given in Table 2.8 were published from 2012 to 2022, nine of them are book chapters, and the remaining 75 are research articles. All of the

nine book chapters are presented in blind peer-reviewed conferences and published in a book, for instance, information and communication technologies in tourism (7 chapters) and augmented reality and virtual reality (2 chapters).

Most of the research articles are published in high-quality journals like Tourism Management (9 articles), Sustainability (6 articles), Journal of Travel Research (5 articles), Journal of Destination Marketing & Management (4 articles), Journal of Hospitality and Tourism Technology (4 articles), International Journal of Hospitality Management (3 articles), Journal of Business Research (3 articles), and Journal of Vacation Marketing (3 articles).

Table 2.8 Journal/book disseminated research documents related to VR in tourism

S. No.	Journals/book	#
1.	Tourism Management	9
2.	Information and Communication Technologies in Tourism	6
3.	Sustainability	6
4.	Journal of Travel Research	5
5.	Journal of Destination Marketing & Management	4
6.	Journal of Hospitality and Tourism Technology	4
7.	International Journal of Hospitality Management	3
8.	Journal of Business Research	3
9.	Journal of Vacation Marketing	3

Figure 2.5 shows the year-wise publication of research documents. The time period to search the literature was selected from 1995, but no empirical research document was published until 2011. One research document was published each year from 2012 to 2014. In 2015, not a single research document was published, whereas three and two documents were published in 2016 and 2017, respectively. From 2018, the trend of publications drastically increased, where six (7.14%) documents were published in 2018, and 11 (13.09%) documents were published in 2019. 15 (17.85%) articles were published each

year (2020 and 2021), whereas 29 (34.52%) articles were published in 2022. The change in trend can be seen through a 'trend line' given in figure 2.5.

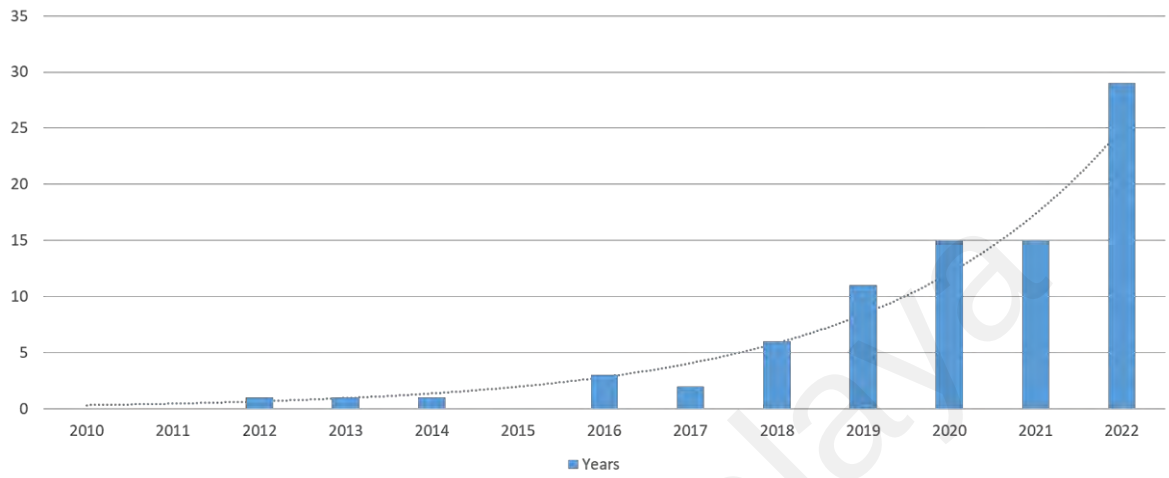

Figure 2.5: Year-wise publications

2.6.1.2 Bibliometric findings

Survey research design is a widely used approach for data collection. 51 (60.71%) research documents used survey research design, whereas 30 (35.71%) documents used experimentation. One document used both survey and experimentation (T. Li & Chen, 2019) and three used mixed method (J. Lu et al., 2022). Some researchers showed VR content to respondents and termed it as a survey. For example, VR scientists collected data at the metro station from passengers by showing the VR cinematic experience of the Fontanelle cemetery in Naples, Italy. They called it intercept survey design (Marasco et al., 2018). Another example of survey design is a cross-sectional design, where researchers showed an underwater VR experience at a marine life centre in France (S. Hudson et al., 2019). The remaining documents that used the survey (without giving a special name such as intercept or cross-sectional) asked respondents to recall their VR experiences in the past or experience VR on the spot.

Several researchers adopted the factorial designs for experimentation (Adachi et al., 2020; Flavián et al., 2019, 2021b; X. Y. Leung et al., 2020; T. Li & Chen, 2019; Weng et al., 2021; Yung et al., 2021; Zeng et al., 2020). Some researchers used different groups in the form of preview modes (Bogicevic et al., 2019, 2021; Flavián et al., 2021a; Hopf et al., 2020; Lo & Cheng, 2020; McFee et al., 2019; Skard et al., 2021; Wagler & Hanus, 2018; Wen & Leung, 2021; Willems et al., 2019). Chiao et al. (2018) used quasi-experimentation for studying pre and post data, whereas researchers also conducted experimentation without involving the control group by showing stimuli (X.-T. Huang et al., 2020; Jung et al., 2016). The methodology used in all research documents is enlisted in table 2.9.

Referring to the unit of analysis, the author has characterised the sample used in these documents into two broader categories, i.e. students and actual users. 27 (32.14%) of the research documents collected data from students, whereas 57 (67.85%) remaining documents collected data from visitors, elders, or the general public. On average, each research document collected data from around 270 respondents, which can be considered a mean of the sample size collected in these research documents.

The researchers use diverse analysis methods to test the hypothesis. For instance, ANOVA, *t*-test, correlation test, structural equation modelling (SEM), PROCESS, and others are mentioned in Table 2.9. SEM is widely used followed by ANOVA and PROCESS.

Table 2.9: Research Methodology

Authors	Research Design	Sample	Analysis
(An et al., 2021)	Survey	220 visitors through convenience sampling	SEM through AMOS
(Adachi et al., 2020)	Experiment	73 students through random sampling	ANOVA
(Alyahya & McLean, 2022)	Experiment	224 and 303 actual users	SEM through AMOS
(Atzeni et al., 2022)	Survey	2085 actual users	SEM through AMOS
(Bogicevic et al., 2019)	Experiment	279 students, staff and faculty from the University through purposive sampling	SEM through Mplus using WLSMV estimator
(Bogicevic et al., 2021)	Experiment	279 students, staff and faculty from the University through purposive sampling	ANOVA, PROCESS Macro
(H. H. Chang, 2022)	Experiment	107 actual users	two-way ANOVA through SPSS
(H. H. Chang & Chiang, 2022)	Survey	342 actual users	SEM through Smart PLS
(Cheng & Huang, 2022)	Survey	509 actual users through convenience sampling	SEM through AMOS
(Chiao et al., 2018)	Experiment	399 students through purposive sampling	Paired sample *t*-test, SEM through AMOS
(Disztinger et al., 2017)	Survey	148 actual users from 29 countries	ANOVA
(Flavián et al., 2019)	Experiment	202 actual users	ANOVA, MANCOVA, PROCESS Macro through SPSS
(Flavián et al., 2021a)	Experiment	141 students through convenience sampling	ANOVA, PROCESS Macro through SPSS
(Flavián et al., 2021b)	Experiment	263 actual users	ANOVA, PROCESS Macro through SPSS
(Geng et al., 2022)	Survey	657 actual users through stratified random sampling	SEM through Smart PLS
(Gibson & O'Rawe, 2018)	Survey	129 actual users	Chi-square analysis
(Han et al., 2014)	Survey	258 actual users through convenience sampling	SEM through AMOS, structural invariance test
(Hofman et al., 2022)	Experiment	114 students through judgment sampling method	ANOVA, MANCOVA
(Hopf et al., 2020)	Experiment	64 students through purposive sampling	Mann-Whitney U-Test, correlation analysis
(Y. C. Huang et al., 2012)	Survey	42 students through convenience sampling	Correlation analysis, regression analysis,
(Y. C. Huang et al., 2013)	Survey	198 students through convenience sampling	SEM through EQS
(Y. C. Huang et al., 2016)	Survey	186 students through convenience sampling	SEM through EQS
(X.-T. Huang et al., 2020)	Experiment	83 actual users	MANOVA, PROCESS Macro through SPSS
(S. Hudson et al., 2019)	Survey	234 actual users	ANOVA, PROCESS through SPSS
(Israel et al., 2019)	Survey	542 students	SEM through Smart PLS
(Itani & Hollebeek, 2021)	Survey	181 actual users through convenience sampling	SEM through Smart PLS
(Jeng et al., 2016)	Survey	305 actual users	SEM through AMOS

Authors	Research Design	Sample	Analysis
(Jung et al., 2016)	Experiment	163 actual users	SEM through Smart PLS
(Jung et al., 2018)	Survey	152 actual users through convenience sampling	SEM through Mplus
(M. J. Kim & Hall, 2019)	Survey	469 actual users through quota sampling	SEM through Smart PLS
(M. J. Kim, Lee, & Jung, 2020)	Survey	408 actual users through quota sampling	SEM through Smart PLS
(M. J. Kim, Lee, & Preis, 2020)	Survey	499 actual users through quota sampling	SEM through Smart PLS
(J. Kim et al., 2022)	Experiment	118 students	SEM through AMOS and PROCESS macro
(H. Lee et al., 2020)	Survey	269 actual users through random sampling	SEM through AMOS
(M. Lee et al., 2020)	Survey	247 actual users through convenience sampling	SEM through Smart PLS
(S. A. Lee et al., 2021)	Survey	278 actual users through convenience sampling	SEM through Smart PLS
(U. K. Lee, 2022)	Survey	182 actual users	SEM through Smart PLS
(W. K. S. Leung et al., 2022)	Survey	285 actual users through convenience sampling	SEM through Smart PLS
(X. Y. Leung et al., 2020)	Experiment	169 students through convenience sampling	ANOVA, MANCOVA, MANOVA, Paired sample *t*-test
(Y. Li et al., 2021)	Survey	542 actual users through convenience sampling	SEM through R
(T. Li & Chen, 2019)	Survey & experiment	290+294 actual users	Regression analysis
(L. P. Lin et al., 2020)	Survey	308 actual users through convenience sampling	SEM through AMOS
(Lo & Cheng, 2020)	Experiment	203 students through convenience sampling	ANOVA, SEM through Smart PLS
(J. Lu et al., 2022)	Interviews & Survey	30 + 1288 actual users	Nonparametric statistical methods, logistic regression
(Manchanda & Deb, 2022)	Survey	484 actual users	SEM through AMOS
(Marasco et al., 2018)	Survey	450 actual users through random sampling	SEM through Mplus
(Martínez-Molés et al., 2022)	Experiment	128 actual users	SEM through AMOS
(McFee et al., 2019)	Experiment	156 students through convenience sampling	Correlation test, *t*-test
(McLean & Barhorst, 2021)	Experiment	270 students and 409 actual users through convenience sampling	SEM through AMOS
(Melo et al., 2022)	Experiment	80 actual users through convenience sampling	Two-way ANOVA through SPSS
(Nam et al., 2022)	Survey	245 students through random sampling	SEM through Smart PLS
(Oncioiu & Priescu, 2022)	Survey	824 actual users through simple random sampling	SEM through Smart PLS
(Özekici & Küçükergin, 2022)	Survey	300 actual users	SEM through Smart PLS
(Pasanen et al., 2019)	Survey	221 actual users through convenience sampling	Chi-square, independent sample Mann-Whitney U-test, regression analysis

Authors	Research Design	Sample	Analysis
(Rauscher & Humpe, 2022)	Experiment	314 actual users through convenience sampling	SEM
(Sancho-Esper et al., 2022)	Survey & focus group	120 actual users	SEM through Smart PLS
(Sarkady et al., 2021)	Survey	193 actual users through convenience sampling	SEM through AMOS
(Schiopu et al., 2021)	Experiment	89 students through convenience sampling	*t*-test, regression analysis, sobel test
(Schiopu et al., 2022)	Survey	1320 actual users through snowball sampling	SEM through AMOS
(Skard et al., 2021)	Experiment	103 students	*t*-test, PROCESS Macro through SPSS
(Talwar et al., 2022a)	Survey	359 actual users through random sampling	SEM through AMOS and PROCESS macro
(Talwar et al., 2022b)	Survey	350 actual users	SEM through AMOS and PROCESS macro
(Trunfio et al., 2022)	Survey	576 actual users through convenience sampling	Correlation, IPA, net promoter through SPSS
(Tsai et al., 2022)	Survey	386 actual users	SEM through Smart PLS
(Tussyadiah et al., 2017)	Survey	202 students	ANOVA
(Tussyadiah et al., 2018)	Survey	202 students from Japan and 724 actual users from UK	Covariance-based SEM with MLM
(Vishwakarma et al., 2020b)	Survey	208 students, staff and faculty from the University through purposive sampling	SEM through AMOS, Multi group analysis
(Vishwakarma et al., 2020a)	Survey	259 actual users	SEM, Multi group analysis
(Wagler & Hanus, 2018)	Experiment	116 students through convenience sampling	ANCOVA, PROCESS Macro through SPSS
(Wang et al., 2022)	Survey	693 actual users	SEM through AMOS
(W. Wei et al., 2019)	Survey	396 actual users	PROCESS through SPSS
(Wen & Leung, 2021)	Experiment	203 students through convenience sampling	MANOVA, MANCOVA, PROCESS Macro through SPSS
(Weng et al., 2021)	Experiment	162 actual users through purposive sampling	MANOVA, ANOVA, SEM
(Willems et al., 2019)	Experiment	182 students through convenience sampling	ANCOVA, SEM through Smart PLS
(Wu et al., 2019)	Survey	490 actual users through convenience sampling	SEM through AMOS
(Wu & Lai, 2022)	Survey	320 actual users through time-based systematic sampling	SEM through Smart PLS
(C. Yang et al., 2022)	Survey	542 actual users through random sampling	SEM through AMOS
(H. Yang & Han, 2020)	Survey	162 actual users through convenience sampling	SEM through Smart PLS
(T. Yang et al., 2021)	Survey	260 actual users through convenience sampling	SEM through Smart PLS
(Ying et al., 2022)	Experiment	254 students	ANOVA, PROCESS through SPSS
(Yuce et al., 2020)	Survey	229 actual users through convenience sampling	SEM through Smart PLS

Authors	Research Design	Sample	Analysis
(Yuen et al., 2022)	Survey	451 actual users through purposive sampling	SEM through AMOS
(Yung et al., 2021)	Experiment	72 actual users through non-probability sampling	ANOVA, Correlation, multiple regression analysis
(Zeng et al., 2020)	Experiment	224 students through convenience sampling	ANOVA
(Zheng et al., 2022)	Interviews & survey	434 and 522 actual users	SEM through AMOS

Note: SEM, structural equation modelling; ANOVA, Analysis of Variance; ANCOVA, Analysis of covariance; MANOVA, Multivariate analysis of variance; MANCOVA, multivariate analysis of covariance; SPSS, Statistical Package for Social Sciences; PLS, partial least squares; AMOS, Analysis of Moment Structures; WLSMV, weighted least square mean and variance adjusted

2.6.2 Theories, stimuli, and constructs used in research documents on VR in tourism

Yung and Lattimore (2019) highlighted the lack of theory-based research in VR and tourism. Afterwards, researchers prefer to adopt theory in their research (see Table 2.14). Forty-nine research documents used theories, where technology acceptance model (TAM) is widely applied in the research documents.

Prior studies have demonstrated the use of different concepts to study consumer behaviour. The author systematically analysed the VR literature published in the context of tourism to identify the developments in literature and to identify potential research gaps (see section 2.9.1). The list of constructs used as independent variables or stimuli in experimentation, moderator, mediator, and processing variables are mentioned in Table 2.14. Furthermore, the framework given in figure 2.6 summarises the important concepts that are used by the researchers.

2.6.2.1 Stimuli of VR vs non-VR or VR HMD vs non-HMD

The different preview modes such as VR vs non-VR or VR through HMD vs non-HMD are used in the literature to study their impact on users. VR usage is evident to give actual knowledge to tourists about the services or products being offered by the hospitality and tourism sectors. Marketers are trying to develop integrated marketing communication

networks to inform potential tourists about the attractions at tourism destinations, available adventurous activities, residing options, interior design, features, location, atmosphere, and amenities. Therefore, marketers implement interactive and sensory-rich ways to attract potential tourists through images, 2-D videos, 360° web-based tours, and VR (Bogicevic et al., 2021). These different preview modes have different technical abilities and affordances to depict the audio-visual spatial outlook and varying degrees of interactivity to attract the tourist. The degree of interactivity can be characterised as how a user can manipulate the virtual environment (Bogicevic et al., 2021).

In contrast with the images, 360◦ tours can provide an interactive experience to potential tourists by allowing them to simulate movement and rotation by changing the observing view in the computer-generated environment (Lurie & Mason, 2007). However, tethered-VR is more immersive than 360◦ tours because VR further extends the interactivity to manipulate the computer-generated environment by providing immediate and real-time feedback. The users have better control, navigation, and interaction with virtual objects while experiencing tethered-VR (Elmezeny et al., 2018; Ryan, 2015). Tourists reported diverse decision making and judgements after experiencing the same content through different preview modes having different levels of interactivity and realism experiences, such as images, 360◦ tours, and tethered-VR (Bogicevic et al., 2021). Skard et al. (2021) compared VR with non-VR preview mode and mentioned that *"the ability of VR to engage consumers in affective forecasting is an important explanation for its influence on consumer behaviour… VR has a positive effect on happiness predictions"* (p. 5). The same is argued by Bogicevic et al. (2021) *"an increase in consumers' visit intentions after the VR preview of an extended-stay suite of a new hotel brand, compared to the more traditional preview modes, i.e., static images and 360◦ tour, and purported*

similar findings about the enhanced tourists' behavioural intentions after VR experiences" (p. 6). Recently, a drastic change has been observed in a market, where destination marketing organisations have shifted their interest from 2D images to 3D visual content through virtual worlds or 360◦ web-based tours (Sundar et al., 2015). Destination marketing organisations have taken advantage of this change because it helps in increasing brand equity and consumers' favourable brand attitude (Bogicevic et al., 2021).

The debate among researchers is also seen over recent years to identify the best synthetic VR experience for users (Beck et al., 2019). As discussed earlier, VR is better than other traditional marketing tools, so a significant question arises "do consumers have easy access to virtual reality head-mounted displays?" The general cases of the United States of America (USA) and Germany are discussed here regarding the consumer adoption of devices that can be used to experience VR content. A total of 85 % of Americans have a smartphone, and 77 % of Americans have a laptop or desktop computer (Pew Research Center, 2021). Smartphone owners are fewer in Germany than in the USA, where 73 % of Germans have smartphones (Koptyug, 2021). On the other hand, highly immersive HMDs are costly for consumers [e.g., Vive or Oculus] (Kangpan, 2018). Hence, *"it is reasonable to conclude that most travelers tend to access 360-degree travel videos on their computers or smartphones compared to a trip to the mall or the expo show for an on-the-spot trial of an HMD"* (Adachi et al., 2020, p. 2-3). Despite this, several researchers tried to uncover the role of VR HMD vs VR non-HMD on consumer behaviour. Therefore, the term 'invasiveness' (other than immersiveness, interactivity, etc.) is also used by Carrozzino and Bergamasco (2010) to differentiate the different types of VR. Wearable devices have higher invasiveness, whereas non-wearable have less invasiveness (Carrozzino & Bergamasco, 2010).

Beck et al. (2019) clearly explained this phenomenon in the context of tourism to overcome the ambiguity by stating that *"Virtual Reality, in a tourism context, creates a virtual environment by the provision of synthetic or 360-degree real-life captured content with a capable non-, semi or fully immersive VR system, enabling virtual touristic experiences that stimulate the visual sense and potentially additional other senses"* (p. 591). In both non-immersive and semi-immersive VR, users have contact with their immediate physical surroundings (McLean & Barhorst, 2021). Desktop-based VR and VR through other peripheral devices (smartphones or tablets without HMD) are also known as non-immersive VR (Dörner et al., 2013). It is the easiest, simplest, and most common method to experience VR. The users can interact with non-immersive VR: by using the mouse to click and drag to reconnoitre all views; by using a keyboard to change the viewpoints and scenes; and by moving the smartphone/tablet with hands to explore the whole virtual environment (Dörner et al., 2013). The semi-immersive VR also does not need technology attached to the user. Rather, it consists of several computer screens or a big screen surrounding the user to involve them in 360° content, and it also has a 3D sound system. The user can manipulate and interact with the view by touching and clicking on the information points (Beck et al., 2019). The most immersive form of VR is through HMD, which must be attached to the user's head (McLean & Barhorst, 2021). Modern HMDs can provide ultra-high-definition vision, sound, and a sense of head movement in a 360-degree dimension that perfectly blends real movement with a computerised environment (Wheeler, 2016). HMD provides a display through the screen to each individual eye. The change of scene and orientation of VR content is controlled by the sensors affixed to the helmet that senses the movement of the head and provides a real-time new perspective of VR film.

The researchers have compared the impact on consumers from VR through HMD vs non-HMD, and most of the studies have reported the superiority of VR content shown through HMD. McLean and Barhorst (2021) concluded that *"VR can provide advantageous outcomes for both hotels and tourism consumers through creating multisensory experiences that offer an authentic representation of a venue's facilities in the virtual environment"* (p. 13). Adachi et al. (2020) also mentioned that *"participants who used an HMD compared to a computer watched exactly the same tourism video but reported a higher level of destination image formation including cognitive, affective, and overall evaluation of the promoted location"* (p. 10). Conclusively, consumers prefer VR through HMD. Hence, they can purchase less costly HMD for their personal usage or visit the nearest marketer, mall, or expo to experience the VR through HMD. Because of this reason, the market share of HMDs is increasing, as discussed by Adachi et al. (2020):

> *"Standalone HMDs are expected to reflect 33% of the market share by 2023, an increase of more than 15% from 2018, due to reduced price ranges as well as an increase in devices coming to the marketplace (e.g. from Samsung, Facebook, HTC and Playstation). The growth of the HMD market share is noteworthy, as a strong body of literature suggests HMDs provide more immersive experiences compared to a computer... In addition, the user's eyes, ears and actions are enveloped into a world solely connected to the virtual"* (p. 3).

2.6.2.2 Independent variables

As discussed earlier, all of the research documents were analysed to summarise VR literature in tourism. This subsection presents variables that are repeatedly used in several studies. Therefore, three main classifications are adopted in this research to categorise

different independent variables into similar classifications, including utilitarian, hedonic, and psychological state.

Utilitarian

The utilitarian classification deals with the user's rational evaluation for using technology to fulfil a specific purpose and solve a problem (Babin et al., 1994). Utilitarian is more cognitively driven, instrumental, goal-oriented and accomplishes a functional or practical task (Dhar & Wertenbroch, 2000; Strahilevitz & Myers, 1998). Utilitarian classification in this research consists of informativeness, cognitive image, perceived usefulness, perceived ease of use, and perceived authenticity (see Table 2.10).

Table 2.10: Utilitarian constructs

Constructs	Definition
Informativeness	The extent to which a user can get important information from a media (M. J. Kim, Lee, & Preis, 2020).
Cognitive image	It is a cognitive evaluation that refers to a person's knowledge about and assessment of the objective attributes of a location (Adachi et al., 2020).
Perceived usefulness	The extent to which a user believes that a specific media would be useful for what they want to do (Yeh & Teng, 2012).
Perceived ease of use	The extent to which a user believes that using a specific media would require less effort (F. D. Davis, 1989).
Perceived authenticity	The sensibility or perception of a consumer that the provided services/products are real in terms of originality, novelty, and uniqueness (Gilmore & Pine, 2007).

Hedonic

The hedonic classification is related to the feelings and emotions of the user, which depends on the judgement after the usage experience (Babin et al., 1994). Hedonic is primarily characterised by an affective and sensory experience of aesthetic or sensual pleasure, fantasy, and fun (Dhar & Wertenbroch, 2000; Hirschman & Holbrook, 1982). Hedonic classification in this research consists of variables such as entertainment, affective image, and perceived enjoyment (see Table 2.11).

Table 2.11: Hedonic constructs

Constructs	Definition
Entertainment	It is "an activity that provides amusement and pleasure" (Benny, 2015, p. 7).
Affective image	It is an individual's feelings and emotions for the location. Affective image can be fun/boring, enjoyable/unenjoyable and pleasant/unpleasant (Adachi et al., 2020).
Perceived enjoyment	'The degree to which the activity of using technology is perceived to be enjoyable in its right apart from any performance consequences that may be anticipated.' (Davis et al., 1992, p. 1113).

Psychological state

The psychological state classification is a perception of users in which they feel themselves in a computer-mediated environment (McLean & Barhorst, 2021). Vividness, interaction, telepresence, focused attention, temporal distortion, perceived immersion, and technological embodiment are those constructs that are placed in psychological state classification (see Table 2.12).

Table 2.12: Psychological-state constructs

Constructs	Definition
Vividness	Vividness is defined as the richness of a computerised environment through which information is presented to the user's senses (Steuer, 1992).
Interaction	Interaction in VR deals with the visual exploration of a computerised environment (Wu et al., 2019).
Telepresence	It is a characteristic of a technology that generates a computer-mediated environment in which the user feels themselves in an artificial environment as compared to the immediate real or physical environment (Steuer, 1992; Suh & Chang, 2006).
Focused attention	The mesmerizing experience in which an individual's concentration is attracted towards a specific activity (Webster et al., 1993).
Temporal distortion	The experience in which an individual has a specious sense of time loses track of real time and feels that time passes faster than real-time (Sherry, 2004).
Perceived immersion	It is "an individual's ability to engage in a virtual environment fully" (Disztinger et al., 2017, p. 262).
Technological embodiment	"The degree of contact between the device and the human senses" (Flavián et al., 2021a, p. 3).

2.6.2.3 Outcome

Behavioural intention in the form of visit intention, intention to play, booking intention, purchase intention, continuance intention, intention to recommend, and ongoing

participation intention are mostly studied as outcome or dependent variables in research documents (see Table 2.13).

Table 2.13: Outcomes or dependent variables

Constructs	Definition
Visit intention	It is a user's overall willingness to visit a destination (Tussyadiah et al., 2018) or brand shown in VR (Bogicevic et al., 2021).
Intention to play	Intention to play is a construct that investigates the user's willingness to play golf through VR (Han et al., 2014).
Purchase intention	Purchase intention is known as the probability that users will buy the brand shown in VR (Lo & Cheng, 2020).
Ongoing participation intention	Ongoing participation intention refers to the possibility that a user will continue participating in a specific event (Jeng et al., 2016).
Continuance intention	It is defined as an individual's willingness to use VR in the future (H. Yang & Han, 2020).
Intention to recommend	The likelihood that a user will recommend VR for a virtual tour (Wagler & Hanus, 2018).
Loyalty	Loyalty refers to a visitor's willingness to rebuy the product/service shown in VR (M. J. Kim, Lee, & Jung, 2020).
Destination image	Destination image is an individual's perception of a place, knowledge, ideas, beliefs and imagination (Crompton, 1979).
Subjective well-being	It is a vital component of improving quality of life, positive mental and physical health (Angner, 2010).
Tourism brand experience	Tourism consumers experiencing the brand through VR, which gives them sensory, behavioural, affective and intellectual experience (Bogicevic et al., 2019).

Table 2.14: Theories and constructs adopted in research documents related to VR in tourism

Authors	Theories used	Independent variables/stimuli	Moderator/ Mediator/ Processing constructs	Outcome
(An et al., 2021)	Flow theory	Sense, quality of information	Telepresence, focused attention, temporal distortion	Satisfaction, visit intention
(Adachi et al., 2020)	Destination image model	Media (HMD vs computer), information guide (tour guide vs peer)	Self-presence, cognitive image, affective image, overall image	Intention to visit
(Alyahya & McLean, 2022)	-	Mental imagery, sense of presence	Higher sensory rich VR experience, attitudes toward the destination	Visit intention
(Atzeni et al., 2022)	SOR	Objective and existential authenticity, cognitive and affective response	VR attachment, satisfaction	Intention to visit
(Bogicevic et al., 2019)	-	Elaboration of mental imagery, quality of mental imagery	Sense of presence	Tourism brand experience
(Bogicevic et al., 2021)	-	Preview mode (images vs 360º tour vs VR)	Technology innovativeness trait, perceived coolness, self-brand connection	Visit intentions towards the brand
(H. H. Chang, 2022)	-	VR vs YouTube videos vs Facebook & travel pages	Acceptance of new technologies, tourism image, flow factors (realness, interactivity, friendliness, telepresence)	Tourism marketing effects
(H. H. Chang & Chiang, 2022)	Flow theory	Friendliness, telepresence	Destination image, flow	Attitude
(Cheng & Huang, 2022)	Pleasure–arousal–dominance model	Dominance, pleasure, arousal	-	WOM, continuous usage intention
(Chiao et al., 2018)	Unified Theory of Acceptance and Use of Technology	Performance expectancy, effort expectancy, social influence, interaction, facilitating condition	Intention to use	Behavioural use
(Disztinger et al., 2017)	Technology Acceptance Model	Perceived usefulness, perceived ease of use, perceived enjoyment, perceived immersion, interest, accessibility, scepticism, technology anxiety, personal innovativeness	-	Behavioural intentions
(Flavián et al., 2019)	-	Technological Embodiment	Immersion, sensory stimulation, active/passive tourism	Engagement, behavioural intentions

Authors	Theories used	Independent variables/stimuli	Moderator/ Mediator/ Processing constructs	Outcome
(Flavián et al., 2021a)	-	Technological embodiment (360º videos displayed on desktop computers vs smartphones vs VR headsets)	Emotional reactions	Psychological engagement, behavioural engagement
(Flavián et al., 2021b)	-	Technological embodiment (low PC vs high VR HMD)	Sensory stimulation, ambient scent, ease of imagination	Destination image
(Geng et al., 2022)	TAM and AIDA	Perceived usefulness, perceived ease of use, interest	Desire, attitude	Intention to tourism
(Gibson & O'Rawe, 2018)	Technology Acceptance Model	Perceived usefulness, perceived ease of use	-	Behavioural intentions
(Han et al., 2014)	Theory of Planned Behavior	Behavioural beliefs, normative beliefs, control beliefs	Attitude, subjective norms, perceived behavioural control, environmental concern, past behaviour	Intention to play screen golf
(Hofman et al., 2022)	-	Commitment to the protection of the environment, environmental concern	-	Intention to engage in conservation behaviours
(Hopf et al., 2020)	-	VR (non-multisensory vs multisensory)	Involvement/ control, adaptation/ immersion, sensory fidelity, interface quality,	Presence, intention to recommend
(Y. C. Huang et al., 2012)	Flow Theory	Challenges, skills, interaction, telepresence	Flow	Behavioural intentions
(Y. C. Huang et al., 2013)	Technology Acceptance Model	Perceived ease of use, perceived usefulness	Enjoyment, positive emotions, emotional involvement, flow	Behavioural intentions
(Y. C. Huang et al., 2016)	Technology Acceptance Model, Self-Determination Theory	Relatedness, competence, autonomy, perceived usefulness, perceived ease of use	-	Enjoyment, behavioural intentions
(X.-T. Huang et al., 2020)	Flow theory	VR experience type (sightseeing vs interactive)	Arousal (self-reported measure, heartrate measure), control (self-reported measure)	Flow (focused attention, time distortion, enjoyment)
(S. Hudson et al., 2019)	-	Person-VE interaction	Immersion, social interaction	Satisfaction, loyalty
(Israel et al., 2019)	Technology acceptance model	Telepresence	Perceived usefulness, perceived enjoyment, curiosity	Booking intention
(Itani & Hollebeek, 2021)	Protection motivation theory	Threat appraisal (perceived severity, perceived susceptibility), coping appraisal (self-efficacy, response efficacy)	Social distancing	During and post covid-19 pandemic (VR tour intentions, in-person tour intentions), VR advancement needs, advocacy intentions toward VR tour

Authors	Theories used	Independent variables/stimuli	Moderator/ Mediator/ Processing constructs	Outcome
(Jeng et al., 2016)	-	Experience seeking, experience quality	Experience values	Purchase intention, ongoing participation intentions
(Jung et al., 2016)	Experience Economy Theory, Social Presence Theory	Social presence	Education, esthetics, entertainment, escape	Visitor experience, intention to revisit
(Jung et al., 2018)	-	Service quality, entertainment, social influence	Satisfaction	Satisfaction, willingness to pay extra for VR experience
(M. J. Kim & Hall, 2019)	Hedonic motivation system adoption model	Perceived easiness, perceived usefulness, perceived enjoyment	Flow, Moderator-visit and non-visit groups	Subjective well-being, continued use
(M. J. Kim, Lee, & Jung, 2020)	-	Authentic experience	Cognitive response, affective response	Attachment to VR, visit intention
(M. J. Kim, Lee, & Preis, 2020)	Innovation Diffusion Theory, Uses and Gratifications Theory	Simplicity, benefit, compatibility, informativeness, social interactivity, playfulness	Authentic experience, subjective well-being, technology readiness, innovativeness	Behavioural intention
(J. Kim et al., 2022)	-	Spatial presence, enjoyment	Destination image	Behavioural intention, willingness to pay
(H. Lee et al., 2020)	Experience Economy Theory	Education, escapism, entertainment, esthetic	Overall VR museum experience	Offline museum visit intention
(M. Lee et al., 2020)	Information success model	Content quality, system quality, vividness	Attitude toward the VR, telepresence	Behavioural intention
(S. A. Lee et al., 2021)	Media richness theory	Vividness, interactivity	Media richness	Information sharing behaviour, information seeking behaviour
(U. K. Lee, 2022)	Media richness theory and the information system success model	Media richness, perceived usefulness, perceived enjoyment,	Satisfaction	Destination visit intention, and positive word-of-mouth intention
(W. K. S. Leung et al., 2022)	-	Synchronicity, two-way communication, active control	Memorable experiences	Continuance intention, WOM

Authors	Theories used	Independent variables/stimuli	Moderator/ Mediator/ Processing constructs	Outcome
(X. Y. Leung et al., 2020)	Perceptual load theory, elaboration likelihood model	Commercial type (VR vs traditional)	Elaboration likelihood	Immediate effects (ad cognition, ad attitude, brand attitude, purchase intention), delayed effects (ad memory, brand awareness, brand attitude, purchase intention)
(Y. Li et al., 2021)	-	Peripheral attribute, core attribute, pivotal attribute	Presence, functional value, emotional value	Satisfaction, subjective well-being
(T. Li & Chen, 2019)	Technology Acceptance Model	Perceived ease of use, perceived usefulness	Perceived enjoyment, expected enjoyment	Travel intention
(L. P. Lin et al., 2020)	-	Destination image, nostalgia	VR effects	Slow travel intentions
(Lo & Cheng, 2020)	Transportation imagery model	Three conditions (Reading a blog on a mobile phone vs VR 360^0 video on a mobile phone vs VR on a cardboard)	Presence, attitude toward the advertised hotel	Purchase intention
(J. Lu et al., 2022)	Theory of Planned Behaviour	Awareness, travel desire, social norm, perceived behavioural control, willingness to access virtual tourism, frequency of browsing	-	Attitude towards virtual tourism
(Manchanda & Deb, 2022)	-	Total immersion, perceived risk	Satisfaction with a destination	Intention to visit a destination, loyalty towards a destination
(Marasco et al., 2018)	-	Perceived visual appeal, emotional involvement of the user	-	Behavioural intention to visit/revisit
(Martínez-Molés et al., 2022)	-	Presence, enjoyment	Brand attitude, product knowledge	Purchase intention
(McFee et al., 2019)	Destination Image Model	Involvement	Cognitive image, affective image	Intention to visit
(McLean & Barhorst, 2021)	-	Three preview modes (VR headset vs 360^0 video vs static image), authentic experience, cognitive processing of mental imagery, quality of mental imagery	Immersion in experience, satisfaction with actual hotel appearance	Learning, visit intention, revisit intention
(Melo et al., 2022)	-	VR setups (audio visual vs multisensory)	Satisfaction, sense of presence, emotions, perceived usefulness	Attitudes, intention to use

Authors	Theories used	Independent variables/stimuli	Moderator/ Mediator/ Processing constructs	Outcome
(Nam et al., 2022)	TAM and hedonic theory	System quality	Authenticity, presence	Satisfaction
(Oncioiu & Priescu, 2022)	UTAUT and Behavioral Intention Model	Social influence, effort expectancy, performance expectancy, facilitating conditions	-	Behavioural intention
(Özekici & Küçükergin, 2022)	TRAM	Technology readiness, perceived usefulness, perceived ease of use	COVID-19 anxiety, social contact	attitudes toward VR, behavioural intention
(Pasanen et al., 2019)	Media Richness Theory	Attention, interest, desire, action	-	Travel intentions, behaviour
(Rauscher & Humpe, 2022)	Unified Theory of Acceptance and Use of Technology 2	Performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, habit	Age, gender, experience	Behavioural intention, use behaviour
(Sancho-Esper et al., 2022)	TAM	Technology anxiety, perceived ease of use, perceived utility	Attitude towards VR	Intention to use VR again, intention to recommend destination
(Sarkady et al., 2021)	Technology Acceptance Model	Perceived ease of use, perceived use, perceived risk, perceived severity, presence	-	Behavioural intention
(Schiopu et al., 2021)	-	Perceived ease of use, perceived usefulness, and perceived substitutability, perceived authenticity	Interest	Intention to use VR in tourism
(Schiopu et al., 2022)	SOR and TAM	Structural constraints, interpersonal constraints, intrapersonal constraints, pandemic travel fear, travel motivations	Perceived VR ease of use, perceived VR usefulness	Behavioural intention to use VR in tourism
(Skard et al., 2021)	-	VR vs 2D	Prior experience with destinations, telepresence, mental imagery, predicted happiness	Purchase intentions, ticket purchase
(Talwar et al., 2022a)	SOR	Informational and environmental cues	Attitude toward VR tourism, Eco-guilt, travel mode, Covid-19 vaccination status	Willingness to forgo the pleasure of in-situ tourism, VR continuance intention
(Talwar et al., 2022b)	Expectancy theory	Expectancy, instrumentality, valence	Number of children, daily green behaviours	Pro-environmental behaviour

Authors	Theories used	Independent variables/stimuli	Moderator/ Mediator/ Processing constructs	Outcome
(Trunfio et al., 2022)	-	Exhibition content, general organisation, reception staff	-	Visitor experiences, satisfaction
(Tsai et al., 2022)	-	Tourist involvement, destination image	Sense of presence	Holistic image
(Tussyadiah et al., 2017)	-	Spatial ability, attention allocation	Sense of presence	Attitude
(Tussyadiah et al., 2018)	Technology acceptance model	Presence, enjoyment	-	Behavioural intention to use VR in tourism
(Vishwakarma et al., 2020b)	Value-based adoption model	Benefits (perceived enjoyment, perceived usefulness, perceived immersion), sacrifices (perceived cost, perceived physical risk, perceived complexity)	Perceived value, gender	Behavioural intention to use VR
(Vishwakarma et al., 2020a)	Technology acceptance model	Perceived enjoyment, perceived usefulness, perceived ease of use, perceived immersion	Gender	Intention to use VR
(Wagler & Hanus, 2018)	-	Two-dimensional, 360-degree video, and physically present conditions	Emotional engagement, spatial presence	Tour outreach intentions, sponsor liking
(Wang et al., 2022)	Involvement theory	Pleasure, centrality, sign	Place dependence, place identity	Behavioural intention
(W. Wei et al., 2019)	-	Functional quality, experiential quality	VR presence	Overall satisfaction
(Wen & Leung, 2021)	Theory of embodied cognition	Video type (traditional video vs VR video)	Wine knowledge, online embodiment, offline embodiment	Purchase intention, willingness to pay
(Weng et al., 2021)	AIEDA model	Destination type (cultural vs natural), advertising format (print vs video vs VR)	-	Attention, interest, evaluation (perceived usefulness, perceived credibility), desire, action
(Willems et al., 2019)	-	Virtual representation media (photographs vs 360° video vs VR)	Interactivity, vividness, telepresence, flow, enjoyment	Online purchase intentions
(Wu et al., 2019)	-	VR experiences (immersion, interaction, usability, illusion), VR attachment (dependence, identity, affect, familiarity)	VR experiential satisfaction, VR experiential loyalty	VR experiential advocacy
(Wu & Lai, 2022)	SOR	Vividness	Presence, emotional involvement, flow state, and enjoyment	Intention to take mountain walking tourism

Authors	Theories used	Independent variables/stimuli	Moderator/ Mediator/ Processing constructs	Outcome
(H. Yang & Han, 2020)	Perceived value theory	Content quality, ease of use, visual attractiveness, portability	Utilitarian value, hedonic value	Continuance intention
(C. Yang et al., 2022)	SOR, TAM	Flow experience	Technical optimism, technical discomfort, perceived usefulness, perceived ease of use	Adoption intention, consumption intention
(T. Yang et al., 2021)	-	Sense of presence, telepresence	Enjoyment, involvement, 360° virtual tour experience	Stress reduction
(Ying et al., 2022)	SOR	Telepresence	Social presence, cognition, affection	(Re)visit intention
(Yuce et al., 2020)	Information Systems Success Model	VR information quality, VR system quality, VR service quality	Perceived satisfaction with VR	Intention to visit
(Yuen et al., 2022)	Maslow's hierarchy of motivational needs and TAM	Environmental knowledge, biospheric values, risk perception of marine pollution, social susceptibility, and green self-image	Perceived usefulness, perceived ease of use	VR adoption in marine ecotourism
(Yung et al., 2021)	-	Three media (photos vs traditional video vs VR video)	Presence (spatial presence, engagement, ecological validity/naturalness, negative effects), emotion (valence, arousal)	Intention to visit the cruise, recommend the cruise, and recommend stimuli experience
(Zeng et al., 2020)	-	Review quality, VR applications	-	Behavioural intention
(Zheng et al., 2022)	Dual-processing theory	Elaboration, quality	Learning, negative emotions	Intention to visit

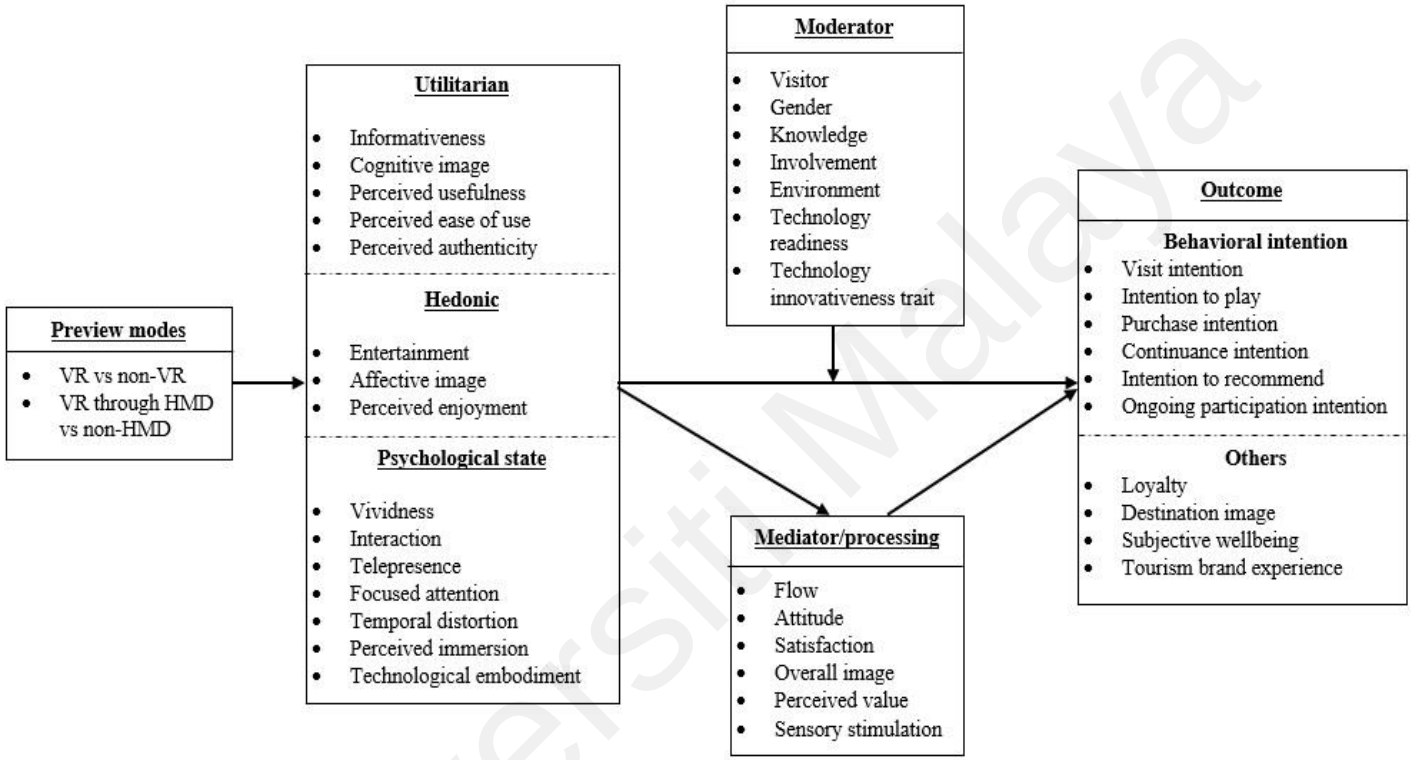

Figure 2.6: Conceptual framework of those constructs that researchers widely study

2.6.3 Conclusion of SLR of virtual reality in the context of tourism

A total of 84 empirical research documents were published from 1995 to 2022. Survey research design is a widely used approach for data collection. The respondents usually experienced 3-DoF VR content, leaving a research gap in studying the impact of the 6-DoF VR experience on consumer behaviour.

Behavioural intention is used as a main dependent variable in most studies. For instance, visit intention, intention to play, booking intention, purchase intention, continuance intention, intention to recommend, and ongoing participation intention. The literature deals with the intentions to use VR for hotel booking or virtual tours and purchasing products or services shown in VR but does not explain the behavioural intentions related to 6-DoF VR. Other dependent variables are loyalty and destination image.

Despite the researcher's interest in VR & tourism, most studies are conducted without involving a specific theory (Bogicevic et al., 2019; S. Hudson et al., 2019; W. Wei et al., 2019; Yung & Lattimore, 2019). Only 11 out of 46 papers reviewed by Yung and Lattimore used theories such as reasoned action, planned behaviour, flow, self-determination, virtual-learning environment, technology acceptance, Delone & McClean information systems success (2019) and social presence (Jung et al., 2016). Tussyadiah et al. (2018) and Yung and Lattimore (2019) expressed their concern about the lack of theory-based research in the context of VR and tourism. Therefore, the trend for using theory changed in 2019, when researchers widely conducted theory-based research, e.g., Protection Motivation Theory (Itani & Hollebeek, 2021), Media Richness Theory (S. A. Lee et al., 2021), Transportation Imagery Model (Lo & Cheng, 2020), Experience Economy Theory (H. Lee et al., 2020), Value-Based Adoption Model (Vishwakarma et al., 2020b), Theory of Embodied Cognition (Wen & Leung, 2021), AIEDA model (Weng et al., 2021), Perceived Value Theory (H. Yang & Han,

2020), Unified Theory of Acceptance and Use of Technology 2 (Rauscher & Humpe, 2022) and Uses and Gratifications Theory (M. J. Kim, Lee, & Preis, 2020). The reviewed research documents do not compare the gratifications for using multi-sensory VR and the fulfilment of those gratifications. Thus, there exists a research gap to study gratification discrepancies through pre and post-experience research.

2.7 Key variables in this research

The variables used in this research are discussed in this subsection. These variables emerged from the interviews (see section 4.4). For example, entertainment, education, novelty, telepresence, pleasantness of experience, reuse, and purchase intentions.

2.7.1 Entertainment

"You are now entering the entertainment zone" is the first chapter of a book written by Wolf (1999) entitled "The Entertainment Economy". Indeed, we live in an entertainment era, where cities like Genting Highlands, Atlantic City, Las Vegas, Macao, Sun City, Monaco, Gold Coast, and others are recognised as "Cities of Entertainment". As also explained by Wolf (1999), *"entertainment content has seeped into every part of the consumer economy…"* (p.4). Researchers and professionals from different research areas have shown a keen interest in studying entertainment. Research documents that mentioned entertainment or related concepts in their titles are from management, communications, psychology, economics, sociology, sports, media, events management, hospitality, and tourism. The specific basic textbooks that discuss entertainment are the experience economy (Pine & Gilmore, 1999), media entertainment (Zillmann & Vorderer, 2000), the dream society (Jensen, 2001), entertainment and society (Sayre & King, 2010), the business of entertainment and its economy (Haupert, 2006; Sayre, 2008; Vogel, 1998; Wolf, 1999), cultural convergence (Jenkins, 2006), the psychology of entertainment (Bryant & Vorderer, 2006), and

events studies (Berridge, 2007; Getz & Page, 2016). Especially, its importance is also evident for tourists because *"for a tourist destination, entertainment is more than just a public good for the local community; since tourists are another major user group and must be considered"* (Loi, 2009, p.24).

Several definitions of entertainment are discussed in the literature. For example, Vogel (1998) defined *"entertainment [a subset of recreation] is that which produces a pleasurable and satisfying experience"* (p. 4). Zillman and Bryant (1994) stated that entertainment evokes emotional responses among audiences, whereas Venkatesh (2000) explained it more generally as an activity that fulfils intrinsic motivations by providing an entertaining and enjoyable experience (Venkatesh, 2000). Loi (2009) defined it specifically in the context of tourism:

"Any revenue-generating activities that are artificial or structured, not practised at home, with tourists as one of the core audience groups, and, upon completion, produce a range of emotional responses that relieve the audience from daily stress. Entertainment is predominantly receptive, but occasionally participative" (p. 36).

The researchers widely use the U&G theory to measure hedonic gratifications (Xu et al., 2012). Because entertainment, in terms of technology, is all about providing playfulness, amusement, and fun to the user (Hausman & Siekpe, 2009). Therefore, it has been used with several technologies such as social media, television, radio, magazines and others (see Table 2.8). It has an impact on consumer behaviour, for example, satisfaction and continuance intention (Bae, 2018), inattentive behaviour and exposure (Levy & Windahl, 1984), viewing satisfaction (C. A. Lin, 1993), media satisfaction (Palmgreen & Rayburn, 1985), media consumption experience (Palomba, 2018), recursive Facebook use (Rokito et al., 2019), attitude toward the online

newspaper and repeat visit intention (Yoo, 2011) and eradication of boredom (Dyer, 2005).

The researchers also explored the impact of entertainment on consumer behaviour in VR and tourism. For instance, to understand the role of VR rollercoaster in user satisfaction and willingness to pay extra for VR experience (Jung et al., 2018), creating the offline museum visit intention (H. Lee et al., 2020), investigating the visitor experience and intention to revisit the museum (Jung et al., 2016).

2.7.2 Education

Education is the learning of new information and enhancing skills as stated by Dewey (1986) *"education consists of bodies of information and of skills that have been worked out in the past"* (p. 242). As Lundgren (2014) described, two major factors influence it: (1) what is essential to know? (2) and what is the social significance of this knowing? Individuals trying to get an education always have some motivation to be fulfilled, such as getting competency to achieve good results, incentives, power, and socialisation (Lynch, 2020). The applications of education are very diverse, and its usage is evident from other research fields, for instance, engineering, medicine, social science, pure science, tourism, and others.

Education is considered very important for tourists along with entertainment. As Oh et al. (2007) mentioned, *"consider the conspicuous trend toward [edutainment] in managing science museums where educational and entertainment experiences merge"* (p. 121). Several researchers have defined education in tourism as the absorption of events by a tourist through active participation at a destination (Oh et al., 2007). Pine and Gilmore (1999) explained it as a tourists' preference to increase knowledge and/or skills through educational events that actively engage the mind and/or the body. Oh et al. (2007) explained it thoroughly:

"With educational experiences, a tourist absorbs the events unfolding before him at a destination, while actively participating through interactive engagement of the mind and/or the body. Typically, tourists increase their skills and knowledge, either general or specific, through educational experiences at the destinations they visit. For instance, visitors to an art festival may learn the historical background of knitting and weaving presented in various ways (brochures, conversations with the artist, etc.) and may increase their skills by trying to weave on a simple loom following the artist's instructions" (Oh et al., 2007; p. 121).

Due to the advancement of information and communication technologies (ICTs), new educational strategies are needed to boost tourism and offer value for e-learning in the tourism industry (Hajli & Lin, 2014). Because ICTs provide tourists a chance to collect information related to tourism destination (Buhalis & Law, 2008) and to get education during tourism activities (Jung et al., 2016). One of the essential gratifications of U&G theory is cognitive gratification, also known as information seeking. It refers to a user's interest in obtaining important, helpful, and valuable information from technological mediums (Athwal et al., 2019; Basak & Calisir, 2015). As discussed earlier, education is also about learning new information and enhancing skills. Hence, in tourism, education causes satisfaction (Bae, 2018; Song et al., 2015) and destination loyalty (Quadri-Felitti & Fiore, 2013). In the same way, education is also studied with VR. For instance, VR provides education to tourists that directly influences visitor experience (Jung et al., 2016) and the positive impact on museum visit intention (H. Lee et al., 2020).

2.7.3 Novelty

Novelty is synonymously known as "unusual or new" words in everyday life. But academically, it is defined as a situation that is not previously encountered or experienced by a person (Barto et al., 2013). O'Keefe and Nadel (1978) described

"*stimulation never before encountered"* (p. 241). It is a "*response to information that is not expected or predicted in a given context on the basis of prior experience"* (Van Kesteren et al., 2012*,* p. 211). Novelty is also conceptualised as the opposite of familiarity (T. H. Lee & Crompton, 1992).

Novelty is being studied in different research areas such as philosophy and cybernetics (George, 1979), creativity and innovations (Sternberg, 1999), artificial intelligence and human-computer interaction (Perner, 2009), economic development (Witt, 2016), tourism (T. H. Lee & Crompton, 1992), marketing (La Ferle et al., 2013), psychology (González-Cutre et al., 2016), and neuroscience (Van Kesteren et al., 2012). In terms of tourism, novelty is defined as a phenomenon that attracts a tourist's attention by giving them a chance to feel different or unique scenarios (T. H. Lee & Crompton, 1992). It is a component of an enjoyable and positive tourism experience that is defined as two inter-related dimensions *"the sense that one is experiencing something new, and the sense that one is experiencing something different from usual daily life"* (Mitas & Bastiaansen, 2018, p. 99). Some researchers explained it as a motivation of a traveller to seek some unique and new activities (Bello & Etzel, 1985) that leads to a positive tourism experience and acts as an antecedent of memorable tourism experiences (Skavronskaya et al., 2019).

2.7.4 Telepresence

In virtual environments, presence has been defined as the observer's sense of psychologically leaving their real location and feeling as if transported to a virtual environment. Put simply, presence is the illusion of *being there* (Heeter, 1992). Importantly, presence *"does not consist of simply reproducing the conditions of physical presence but in constructing environments in which actors may function in an ecologically valid way"* (Mantovani & Riva, 1999, p. 547). Different authors have tried to introduce extended terms of presence to the literature, such as telepresence (Cowan

& Ketron, 2018), virtual presence (Sheridan, 1992), and mediated presence (Bourdon, 2020). Presence is a state in which users are aware of another individual in a computerised environment (Shin, 2013). On the other hand, telepresence is a state in which users feel themselves 'being there' in a computerised remote (Cowan & Ketron, 2018). This research used telepresence as a gratification because visitors mentioned a sense of teleporting in a virtual environment (see section 4.4). Most importantly, telepresence is widely studied with VR in literature (Jung et al., 2016; D. Kim & Ko, 2019; Tussyadiah et al., 2018) and it is considered an important construct for VR-related studies (Shahab et al., 2021).

Telepresence is defined as a technological characteristic that generates a computer-mediated environment in which the user feels themselves in an artificial environment compared to the immediate real or physical environment (Steuer, 1992; Suh & Chang, 2006). Steuer (1992) defined telepresence as "*the extent to which one feels present in the mediated environment, rather than in the immediate physical environment"* (p. 6). For example, telepresence can provide a virtual experience of an actual tourism site while users stay at their homes (Tussyadiah et al., 2018) and users have a sense of visiting an actual shopping store while experiencing it through a virtual environment (Yaoyuneyong et al., 2018).

The importance of telepresence can be understood from research conducted by Hyun and O'Keefe (2012). They concluded that marketers should create a trial version of actual tourism destinations to attract tourists. Their research discussed the same idea given by Smith and Swinyard (1988), in which they recommended that marketers should provide trial versions of a product to attract the consumer. In the same way, telepresence enhances the tourists' visiting experience during the tour (Jung et al., 2016).

2.7.5 Pleasantness of experience

Pleasantness of experience is a collection of positive and negative emotions. It deals with the outcomes of a product or service, for example, happy or unhappy, satisfied or unsatisfied, pleased or annoyed, relaxed or bored, and others (Van Kerrebroeck et al., 2017a). Pleasantness of experience is crucial in the context of immersive media because it directly affects the user's level of engagement. VR creates a sense of presence and transports users to new worlds. However, users can detract from the overall immersive experience if they feel discomfort, such as unpleasant sensory experiences, discomfort from wearing a VR headset, or motion sickness. Therefore, studying pleasantness of experience is essential to understand user behaviour.

2.7.6 Reuse & purchase intentions

This research operationalised the reuse intention as a construct to study the visitors' intention to use multi-sensory VR at tourism destinations. The primary reason for studying reuse intention was an emerging theme from interviews. Secondly, the extant literature on VR and tourism highlighted the importance of continuance intention (H. Yang & Han, 2020), continued use intention (M. J. Kim & Hall, 2019), and behavioural intention to use VR in tourism (Tussyadiah et al., 2018; Vishwakarma et al., 2020a, 2020b). However, researchers have overlooked the reuse intention at a tourism destination. The literature also empirically proves that reuse intention plays a vital role in predicting consumer behaviour (H. B. Kim et al., 2009; So & Kim, 2013). Moreover, other scholars overwhelmingly investigated the role of VR in visiting a specific destination that is shown in VR content (Adachi et al., 2020; An et al., 2021; Bogicevic et al., 2021; Flavián et al., 2019; Y. C. Huang et al., 2012, 2013, 2016; Itani & Hollebeek, 2021; Jung et al., 2016; M. J. Kim, Lee, & Jung, 2020; M. J. Kim, Lee, & Preis, 2020; H. Lee et al., 2020; T. Li & Chen, 2019; Marasco et al., 2018; Pasanen et

al., 2019; Tussyadiah et al., 2018; Wagler & Hanus, 2018; Yuce et al., 2020; Yung et al., 2021). It leaves a research gap in studying the tourist's overall behavioural intention to use multi-sensory VR at other tourism destinations. Therefore, studying reuse intention is necessary to address this gap.

Purchase intention is operationalised as the willingness of a tourist to purchase VR for personal usage. This construct is also considered because of the visitors' motivations for using VR (discussed in sub-section 4.4). Several researchers have studied purchase intention in the context of VR and tourism. For example, Jeng et al. (2016) investigated the purchase intention of a product, Lo and Cheng (2020) explored the purchase intention after experiencing the VR of a hotel advertisement, Wen and Leung (2021) studied the purchase intention for wine, and Willems et al. (2019) investigated the tour purchase intention. However, researchers have overlooked the study of purchase intention of VR. As it is also evident from the literature that users want to purchase a technology after using it (S.-H. Kim, 2010). This construct will also address the major concern of VR that it is not meeting the selling targets and it is not reaching the target audience money-wise. Right now, for companies venturing into and adopting VR, there is virtually no competition in the market. This discourages the development of VR systems and its acceleration in adoption. Empirically studying the visitors' purchase intention for the first time will provide answers to the tourism marketers related to the future of VR.

2.8 Competing Theories

Several other theories are not adopted in this research. Therefore, this sub-section briefly discusses them and justifies their misfit in the context of this research.

2.8.1 Expectation confirmation theory (ECT)

As already discussed, the researchers only used to investigate post-experience behaviour of a product, service, or media before the 1980s. This trend changed during

the 1980s when researchers felt that post-experience study was not enough to understand actual consumer behaviour. Oliver (1980) proposed expectation confirmation theory (ECT) to study the interplay role of pre-consumption (expectation) and post-consumption (perceived performance) variables on consumers' satisfaction and repurchase intention (see figure 2.7). Consumers initially form an expectation of a specific product or service before purchasing that product or service. Secondly, consumers use that product or experience service, and during this initial consumption, they form perceptions about its performance. Third, consumers assess the actual performance of a product or service in contrast to their original expectations and conclude whether the expectations are confirmed. If expectations are confirmed (performance > expectation), the consumer will be satisfied and repurchase a product or continue using the service in the future. If expectations are not confirmed (performance < expectation), it causes disconfirmation, and dissatisfied consumers will not repurchase or discontinuance intention (Oliver, 1980, 1993). Satisfaction in marketing literature is considered an important aspect of maintaining a long-term relationship with consumers and motivates them to stay loyal to the organisation (Anderson & Sullivan, 1993; Oliver, 1981).

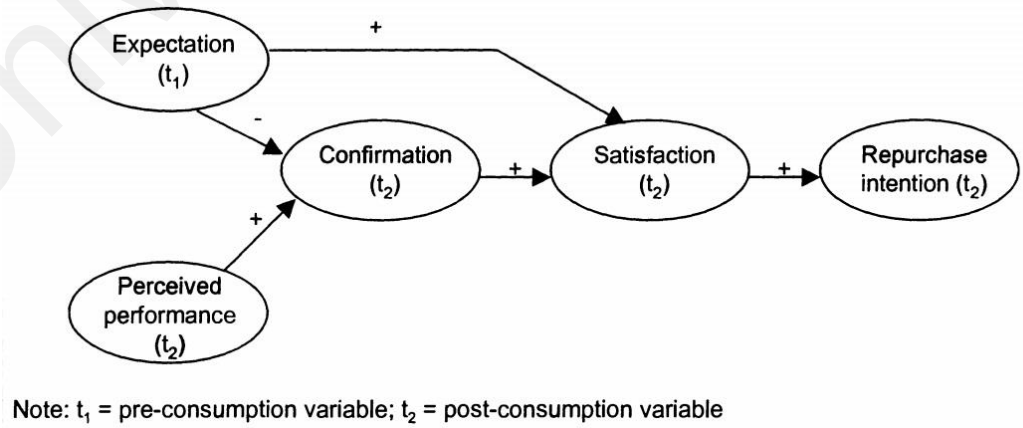

Figure 2.7: Expectation confirmation theory

Several researchers have used ECT to study consumer behaviour (e.g., satisfaction and post-purchase behaviour) with a variety of products and services, for

instance, restaurant service (Swan & Trawick, 1981), automobile repurchase (Oliver, 1993), camcorder repurchase (Spreng et al., 1996), professional business services (Patterson & Spreng, 1997), repurchase of photographic products (Dabholkar et al., 2000), repurchase of online music products (Y.-M. Lin et al., 2015), public transit services (Fu et al., 2018), internet banking services (Rahi & Ghani, 2019) and online repurchasing (Lim et al., 2019).

Bhattacherjee (2001) extended ECT in the context of information systems by stating that:

> *"This paper is one of the earliest to conceptualize and test a theoretical model of IS continuance…based on expectation-confirmation theory (ECT) (Oliver 1980), which is further refined using auxiliary theories and empirical findings from prior IS use research…this study is similar in spirit to Davis et al.'s formulation of the technology acceptance model (TAM) in that it adapts ECT from the consumer behavior literature to propose a model of IS continuance, just as TAM adapted the theory of reasoned action from the social psychology literature to postulate a model of IS acceptance"* (p. 352).

After the introduction of ECT in IS literature, researchers widely used it with several media like continuance intention of online banking (Bhattacherjee, 2001), continued e-learning usage for medical e-learning technology (H.-K. Chou et al., 2010), continued use of a weblog (blog) site (Tang & Chiang, 2010), e-loyalty through bookselling websites (Valvi & West, 2013), product loyalty through mobile advertising (C. C. Lu et al., 2019), continued use of social fitness-tracking apps (J. Li et al., 2019) and continuance intention of smart fitness wearables (Gupta et al., 2020).

However, researchers have also highlighted shortcomings in ECT. For instance, ECT does not measure potential changes in consumers' expectations after purchasing a product or service and the role of those vicissitudes on consumers' cognitive processes (Bhattacherjee, 2001). Expectations before using a product or service are usually based on the opinion of others or information seen through the media. Hence, it cannot be real in some situations. Contrary, post-acceptance expectation is more realistic because it is formed based on first-hand experience (Fazio & Zanna, 1981). If a product or service extends the initial expectation. In that case, the post-consumption expectation (modified) will replace the initial expectation in consumers' cognitive memory to guide subsequent decision processes. This phenomenon is supported by self-perception theory (Bem, 1972) which postulates the continuous change in individuals' perceptions (e.g., expectation) after getting the latest information. Secondly, it does not give leverage to use specialised constructs according to a specific media. Thirdly, ECT is useful in predicting and explaining customer satisfaction and loyalty, as it emphasizes the role of expectations in shaping consumer evaluations (García & Curras-Perez, 2020). Contrary, gratification discrepancies approach can measure several cognitive and emotional/affective responses of consumers, for instance, continuance intention (Bae, 2018), recursive Facebook use (Rokito et al., 2019), interpersonal utility, pass time, entertainment, information seeking, and convenience (Karimi et al., 2014). Hence, the decision to select a theory is primarily linked to the research objectives. This study aims to investigate visitors' pleasantness of experience after using multi-sensory VR, which deals with the emotional and affective responses of consumers to their consumption experiences. Therefore, gratification discrepancies approach is a suitable theory for this research.

2.8.2 SERVQUAL

Today's businesses face challenges due to globalisation and environmental complexities, which have made quality one of the primary tools for success. Many organisations have taken advantage by providing quality services or products through methodical procedures to get a competitive position in the market. Successful organisations usually meet the consumer's expectations and also exceed them (Bhat, 2012).

In literature, several definitions were used to describe the importance of consumers' perception of quality (Takeuchi & Quelch, 1983). These were judgements or attitudes that resulted from comparing consumers' expectations with their perceptions of actual service performance (Berry et al., 1985; Grönroos, 1982; Lewis & Booms, 1983). It was also about satisfying the customer through a service that resulted in a positive attitude towards service. Several researchers also mentioned that service is non-tangible. Therefore, customers usually evaluate service quality through the factors associated with the physical environment (Berry, 1980; Booms & Bitner, 1981). Levitt (1981) also explained the same phenomenon that consumer's judgements are based on appearances. For instance, judging a less tangible product through its packaging. Parasuraman et al. (1985) highlighted the importance of service quality and defined this concept as a gap between customers' expectations of service and their perception of the service experience. Initially, they provided ten factors of service quality. Later on, Parasuraman et al. (1988) eradicated the confusion about service quality by providing a service quality (SERVQUAL) model for the first time to help businesses in identifying their weaknesses and strengths. SERVQUAL was based on the expectation confirmation model (a gap between expectation and perception). This model dealt with five primary service aspects rather than the ten factors presented in 1985. For instance, reliability, assurance, empathy, responsiveness, and tangible (see figure 2.8). These five

dimensions were measured through 22 items, which also helped researchers to investigate the level of service quality along each dimension. Each dimension of the service quality is calculated through a difference score that is known as the quality gap denoted as G = P – E, where P represents perception and E represents expectation.

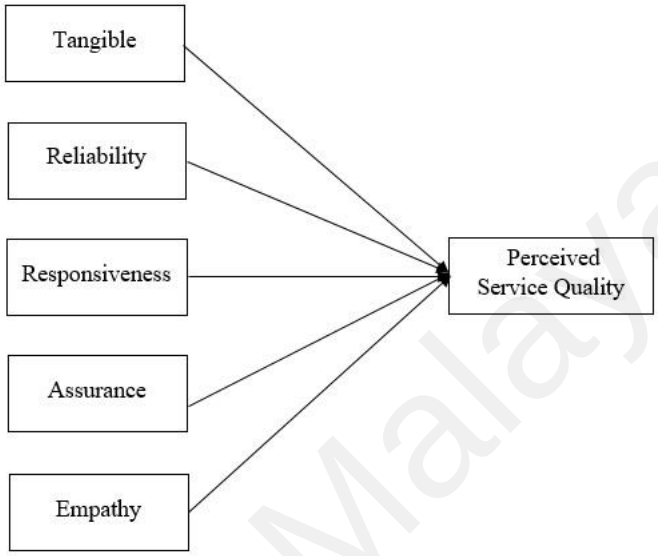

Figure 2.8: SERVQUAL

The researchers used SERVQUAL model to study the service quality of websites (van Iwaarden et al., 2003), IT services (Kang & Bradley, 2002), e-learning services (Udo et al., 2011), classroom experience (Stodnick & Rogers, 2008), health care services (Dean, 1999), hotel services (Fernández & Bedia, 2004), airline services (Pakdil & Aydin, 2007), travel agent services (Bigné et al., 2003), retail store (Zhao, Bai, et al., 2010), banking sector (Ladhari, 2009), spa (Blešić et al., 2014) and others.

Despite the importance of SERVQUAL in marketing literature, there are several shortcomings in this model that researchers identify (Babakus & Boller, 1992; T. J. Brown et al., 1993; Buttle, 1996; Carman, 1990; Cronin & Taylor, 1992). Most prominent are: (1) five dimensions are not universal; (2) service quality in these dimensions are contextualised; (3) expectation terminology is polysemic; (4) and

customer use judgements to evaluate service quality rather than expectations (Buttle, 1996). All of these shortcomings are discussed separately in the following paragraphs.

Firstly, service quality is not confined to only five dimensions proposed by Parasuraman et al. (1988): reliability, assurance, empathy, responsiveness, and tangible. Researchers have mentioned several other factors; for instance, Lehtinen and Lehtinen (1982) identified three factors – corporate quality, physical and interactive. Grönroos (1984) mentioned functional, technical, and reputational quality dimensions. LeBlanc and Nguyen (1988) enlisted five dimensions – tangible support from the service provider, internal organisation, corporate image, the interaction between customer and staff, and the level of customer satisfaction. Hedvall and Paltschik (1989) stated two factors that are psychological & physical access and willingness & ability to serve. Parasuraman et al. (1988) argued that SERVQUAL along with the items to measure service quality is a basic skeleton that encompasses expectations/perceptions phenomenon to study these five dimensions. In 1991, Parasuraman et al. (1991) further refined SERVQUAL by mentioning that these five dimensions are generic dimensions for all service contexts. Therefore, extant literature deals with the applications of SERVQUAL as generic dimensions rather than specific dimensions.

Secondly, five dimensions of SERVQUAL are contextualised and do not work well in other service sectors. A total of nine dimensions studied by Carman (1990) in the context of a hospital yielded 71% of the variance in service quality. These dimensions were tangible food, admission service, tangible privacy, tangible accommodations, explanation of treatment, nursing care, courtesy and access for visitors, discharge, and billing. Gagliano and Hathcote (1994) investigated the role of SERVQUAL scale in the apparel retailing context and concluded that *"the [original SERVQUAL scale] does not perform as well as expected"* (p. 66). Chingang Nde & Lukong (2010) studied SERVQUAL in the context of Sweden's grocery stores and

found that *"SERVQUAL model is not the best tool to use measure service quality in grocery stores"* (p.1).

Third, the term expectation is polysemic. Parasuraman et al. (1988) defined expectations as *"desires or wants of consumers, i.e. what they feel a service provider should offer rather than would offer"* (p. 17). Expectation was proposed to study 'normative expectation', which is similar to 'ideal standard' in the literature on satisfaction/dissatisfaction. Later on, Teas (1993b) declined those explanations in support of expectations by declaring them as *somewhat vague* and mentioned six possible interpretations that a respondent can assume related to expectations (Teas, 1993a): (a) customers may answer items of expectation according to the importance of service attribute; (b) customers may answer to predict the performance they would expect; (c) what performance can be in terms of optimal and ideal performance; (d) feel performance that is also known as deserved performance in the light of their investments; (e) what ought to be the performance according to a perceived set of costs (equitable performance); and (f) what must be the performance that is a minimum tolerable performance. All of these interpretations are different from each other and Teas concluded that variance in the SERVQUAL expectations is different for customers having different interpretations. Parasuraman et al. (1994) addressed these issues by altering normative expectations to expectations from excellent service organisations.

Furthermore, customers use judgements to evaluate service quality rather than expectations. Iacobucci et al. (1994) suggested dropping expectations from SERVQUAL. Therefore, the SERVPERF model was proposed by Cronin and Taylor (1994) that only focused on evaluating received performance. Based on the above-mentioned discussion and research objective to study pre and post VR usage

experiences, it is concluded that gratification discrepancies approach is a suitable theory for this research.

2.8.3 Expectancy-value theory

Motivation plays an important role in an individual's ability to perform well. For instance, the successful completion of an organisational task demands a motivational worker (Galbraith & Cummings, 1967). Students must be motivated to perform well in assignments, examinations, and other educational activities to achieve success in academics (Eccles et al., 1992; Eccles & Wigfield, 2002). A motivated salesperson will work well to achieve the marketing tasks (Nasri & Charfeddine, 2012). Expectancy value theory proposed by Vroom (1964) provides an opportunity to study these types of motivations. According to Vroom, people will engage in activities based on their previous beliefs or perceptions to avoid pain and to get pleasure.

Vroom (1964) postulates that two aspects can understand the action or behaviour of an individual, first is *expectancy*, how much effort is being exerted by a person to achieve a specific outcome. The second is *value*, also known as evaluation after using that media, i.e., attitude, behavioural intention or behaviour (in some cases all three), and outcome from the media (Palmgreen & Rayburn, 1985). These two important aspects can measure motivation by multiplying them with each other, such as expectancy x value. When expectancy and value are high, the motivation will also be high, but motivation will disappear when any one aspect gets zero. The researchers have widely used expectancy-value theory in diverse sectors like human resource management (Galbraith & Cummings, 1967), education (Eccles et al., 1992), marketing (Nasri & Charfeddine, 2012), entrepreneurship (Barba-Sánchez & Atienza-Sahuquillo, 2017), tourism (Correia & Moital, 2009) and others.

The researchers Rayburn and Palmgreen (1984, p.538) described expectancy-value theory as *"either behaviour, behavioural intentions, or attitudes (or all three) as*

a function of (1) expectancy (or belief) – that is, the probability that an object possesses a particular attribute or that a behaviour will have a particular consequence – and (2) evaluation – that is, the degree of affect, positive or negative, toward an attribute or behavioral outcome". In simple words, it deals with the beliefs or expectations from a media and evaluation after using a media (Rayburn et al., 1984). The different models of expectancy-value theory are used in the literature that are formed by integrating expectancy and evaluation, such as the expectancy-value model and expectancy discrepancy model (Palmgreen & Rayburn, 1985). Expectancy value theory in media literature has been used to stalwartly buttress the U&G theory to study the users' desire and expectations for using media by providing a stronger conceptual model (Palomba, 2018). Therefore, researchers have integrated its evaluation concept into the gratifications obtained model and termed it as *the modified gratifications obtained model* (Palmgreen & Rayburn, 1985). Because individuals' expectations or beliefs serve as parallel gratifications sought related to the consumption of media activities (Palmgreen & Rayburn, 1982), in the perspective of U&G, users will be satisfied when gratifications obtained (experience) are more than the gratifications sought (expectation) (Palomba, 2018). Table 2.7 provides a list of literature that employed expectancy-value theory with U&G theory like television (Palmgreen & Rayburn, 1979, 1985), social media (Gibbs et al., 2014; P. R. Johnson & Yang, 2009), and video games (Palomba, 2018).

Several conceptual models derived from U&G and expectancy-value theory are used in the literature (see Gibbs et al., 2014; Palomba, 2018), but the literature cannot highlight the best model to measure the consequences of media consumption by comparing the different frameworks. Palmgreen and Rayburn (1985) tried to fill this void by studying six different models and two transactional models to measure satisfaction through hierarchical regression analysis. The models studied by Palmgreen

and Rayburn (1985) were: (1) gratifications obtained model ∑(GO); (2) modified gratifications obtained model ∑ e(GO); (3) expectancy-value model ∑(be); (4) absolute value discrepancy model ∑ |GS - GO|; (5) simplified discrepancy model ∑(GO - GS); (6) expectancy-value discrepancy model ∑ e(GO - GS); transactional models (7) ∑(GS+GO) and (8) ∑ e(GS+GO). They reported that the expectancy-value model (Model 3: ∑be) yielded a low change in the coefficient of determinant (R^2). Therefore, this research does not use the expectancy-value model due to the lower R^2 values.

2.9 Summary of the literature review

Most VR studies within the tourism context are being conducted without involving a specific theory to examine the influence of VR in the tourism context (Bogicevic et al., 2019; S. Hudson et al., 2019; W. Wei et al., 2019; Yung & Lattimore, 2019). It is also mentioned by Loureiro et al. (2019) *"S-O-R framework has been employed as the core theoretical foundation for studies. However, in the future, researchers may consider other theories and theoretical frameworks…" (p. 12).*

Users always have some needs to use a specific technology, and those needs derive gratifications for using technology. U&G is a suitable theory to understand the gratifications emerging from users' needs (Rauschnabel, 2018b). The researchers have successfully explored the gratifications in VR and tourism (M. J. Kim, Lee, & Preis, 2020), but there exists a gap in studying the comparison of gratifications sought and gratifications obtained.

Several gratification models are used in the literature. Nonetheless, academic literature is unable to highlight the best model to measure the consequences of media consumption by comparing the different frameworks through structural equation modelling. Also, exploring the impact of the best gratification model in forming pleasantness of experience, reuse, and purchase intention.

As already stated, U&G is a suitable theory to address the research gaps because it gives leverage to use specialised constructs according to a specific media rather than having a specific set of constructs to be studied with all media. Therefore, studying the nuanced gratifications with new technologies needed the attention of researchers, for example, education, and telepresence. Section 2.8 discusses the competing theories that have specific constructs and must be used in all research, whereas U&G theory is flexible in studying the new constructs. The same is mentioned by Shahab et al. (2021) about the importance of theories that can accept context-based constructs:

> *"ELM has a lenient approach in accepting new and different variables according to the nature of a research (Petty & Cacioppo, 1986). Unlike other theories, it doesn't have specific independent variables that must be used in all the researches… new technologies are more complex, and old theories are unable to comprehend the new technologies (Fischer et al., 2018). However, new technologies like virtual and augmented reality can be studied with ELM by adopting constructs that are widely used in VR and AR literature, for example, telepresence, perceived augmentation quality, esthetic, and entertainment" (p. 11).*

2.9.1 Research gaps

On the basis of all the discussion mentioned above, this study addresses the following gaps (also see figure 2.9):

1) Museums generally must better understand how innovative exhibits, including VR are perceived by users (Wojciechowski et al., 2004). Previous research in this area is scarce. As a result, museum scholars and managers

alike have a limited understanding of the underlying processes that shape consumer assessment formation (see Hill, 2017). At present, little academic support can be contributed to the development of such exhibits. This study combines previous research from multiple fields, including U&G research, cultural management, and VR, and complements it with preliminary interviews among museum visitors. It proposes conceptual models that are then empirically tested among museum visitors.

2) Most VR studies within the tourism context are conducted without a specific theory (Bogicevic et al., 2019; S. Hudson et al., 2019; W. Wei et al., 2019; Yung & Lattimore, 2019). Contrary, few studies used specific theories until 2019. These theories are Theory of Reasoned Action, Technology Acceptance Model, Theory of Planned Behaviour, Flow Theory, Self Determination Theory, DeLone and McLean Information Systems Success Model, Virtual Learning Environment (Yung & Lattimore, 2019), Social Presence Theory (Jung et al., 2016), Destination Image Model (McFee et al., 2019), Perceptual Load Theory (Leong et al., 2019), and Elaboration Likelihood Model (Leong et al., 2019). Theory-based research got attention after 2019, where researchers used Protection Motivation Theory (Itani & Hollebeek, 2021), Media Richness Theory (S. A. Lee et al., 2021), Transportation Imagery Model (Lo & Cheng, 2020), Experience Economy Theory (H. Lee et al., 2020), Value-Based Adoption Model (Vishwakarma et al., 2020b), Theory of Embodied Cognition (Wen & Leung, 2021), AIEDA model (Weng et al., 2021), Perceived Value Theory (H. Yang & Han, 2020), Unified Theory of Acceptance and Use of Technology 2 (Rauscher & Humpe, 2022) and Uses and Gratifications Theory (M. J. Kim, Lee, & Preis, 2020).

3) Researchers do not give nuanced gratifications enough attention. Sundar and Limperos (2013) suggested studying new gratifications with the latest technology. They argued that *"studies on the uses of the Internet have generated a list of gratifications that are remarkably similar to those obtained from older media ... gratifications are conceptualized and operationalized too broadly (e.g. information-seeking), thus missing the nuanced gratifications obtained from newer media"* (p. 504). Hence, this current study identifies and studies those unique gratifications that are related to multi-sensory VR.

Novelty is defined as a situation that has not been previously encountered or experienced by a person (Barto et al., 2013). Sundar and Limperos (2013) explained novelty as an unusual experience of new technology with a different interface. Sundar and Limperos (2013) explained *being there* as the immersive feeling of being in a 360-degree interactive panoramic view shown through the technology. In the literature focusing on new technologies, the phenomenon of being there is mainly referred to as *telepresence*. Specifically, telepresence is the characteristic of a technology replicating the real scenario in a computer-mediated environment, with users being deeply involved in that environment (Suh & Chang, 2006).

4) Both managers and scholars are interested in researching the users of VR. Prior research in related fields has typically examined how users feel about VR in terms of their expectations/GS (Herz & Rauschnabel, 2019) or their assessments/GO (M. J. Kim et al., 2020). However, the few exceptions in other areas suggest that expectations and assessments do not always match, but consumer reactions may still be positive. The factors that affect visitor

interest in VR may thus be different from those that actually shape the experience. The current study addresses this gap by comparing expectations/GS (before use) with assessments/GO (after use).

5) Different research models are used to study consumer behaviour, such as attitude, behavioural intention, and satisfaction. These models highlight the interplay of GS and GO and their impact on media choice (Palmgreen & Rayburn, 1985). The literature provides conflicting suggestions. For instance, some researchers (Bae, 2018; Karimi et al., 2014) argue that GS must be fulfilled to generate positive reactions. Thus, scholars should use the difference score between GO and GS. Other researchers, however, argue that a simple study of GO is sufficient or even better (Sheldon et al., 2017; Sheldon & Bryant, 2016). The literature thus lacks clear recommendations for measuring media gratifications in general and in the particular context of museum VR. Therefore, the literature cannot provide the best model to study the consequences of media consumption by comparing the different frameworks.

   This research tests various gratification models with new technologies such as VR and thus can guide academic and practical researchers in the development of user studies in VR. Models 1, 2, 3, and 5 are widely used in the literature. This present study uses three new models that are not studied in the literature: Models 4, 6, and 7 (see section 3.2).

6) After getting the best model, this research further used it to study users' reuse and purchase intentions. The primary reason for studying reuse intention was an emerging theme from interviews. Secondly, the extant literature on VR and tourism highlighted the importance of continuance intention (H. Yang & Han, 2020), continued use intention (M. J. Kim &

Hall, 2019), and behavioural intention to use VR in tourism (Tussyadiah et al., 2018; Vishwakarma et al., 2020a, 2020b). However, researchers have overlooked the reuse intention at tourism destinations. It is also empirically proven in the literature that reuse intention plays an important role in predicting consumer behaviour (H. B. Kim et al., 2009; So & Kim, 2013).

Purchase intention is also considered in this research because of the visitors' motivations for using VR (discussed in sub-section 4.4). Several researchers have studied purchase intention in the context of VR and tourism. For example, Jeng et al. (2016) investigated the purchase intention of a product, Lo and Cheng (2020) explored the purchase intention after experiencing the VR of hotel advertisement, Wen and Leung (2021) studied the purchase intention for wine, and Willems et al. (2019) investigated the tour purchase intention. However, researchers have overlooked the study of purchase intention of VR. It is also evident from the literature that users want to purchase a technology after using it (S.-H. Kim, 2010).

7) One of the reasons for studying pleasantness of experience as a mediator is the recommendation provided by Loureiro et al. (2019) after conducting a literature review of 150 research documents published in the context of virtual reality and marketing: *"previous studies tend to regard constructs such as pleasure, arousal, vividness and telepresence as mediators between stimuli and behavioural intentions. However, we suggest other mediators…"* (p. 12). The literature indicates that independent variables in this research, such as entertainment, education, novelty, and telepresence, have a relationship with a pleasant experience. Hence, pleasantness of experience can be studied as a mediator.

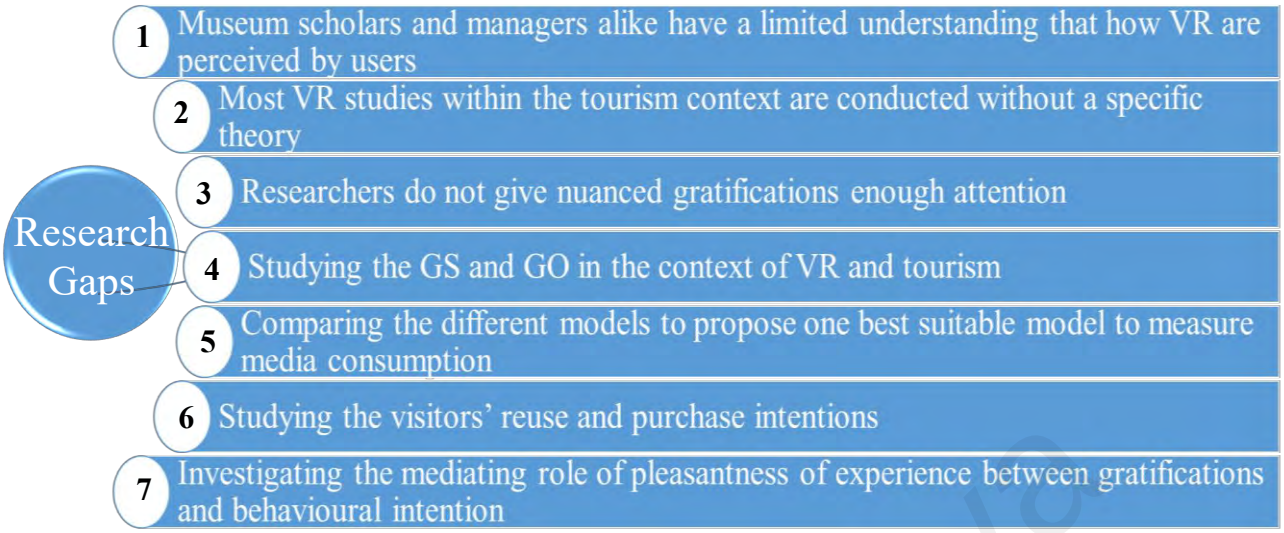

Figure 2.9: Summary of research gaps

2.9.2 Why these research gaps are important to address?

People use the latest technology to get unique and pleasurable experiences (Domina et al., 2012), and researchers have characterised VR as a novel technology (Nagy & Turner, 2019). Also, VR in the context of tourism is at an initial exploratory level without established theories – only 84 empirical research documents are published in this domain – and a few studies have used theories. Yung and Lattimore (2019) mentioned the lack of theory-based research in the context of VR and tourism by stating that *"regardless of the tourism sub-sector, studies on VR and AR to a large extent attempt to understand consumer usage behaviours to then optimise and adapt the technology for the different uses"* (p. 17). The same is cited by Y. C. Huang et al. (2016) on the importance of theory-based research to understand consumer behaviour, *"although a body of academic literature that seeks to understand tourism and Internet innovations has emerged, there is a need for more substantive and theory-based research toward deeper insight into user experience and consumer behavior in 3D virtual worlds in tourism contexts"* (p. 117). Hence, theory-based research in VR and tourism addressed important research gaps as discussed by the scholars.

As already mentioned, people use media to fulfil their specific needs and gratifications. Sundar and Limperos in 2013 extended the usage of U&G theory by proposing its 2.0 version for new technologies. Therefore, empirically studying the under looked nuanced gratifications for the first time causes a strong contribution to academic literature (see Barton, 2013) and enhances the U&G theory by deepening the understanding of users' nuanced gratifications.

The existing literature overwhelmingly discusses positive experiences formed by collecting data at one time without exploring the needs of a tourist. On the contrary, researchers believe that actual experience from technology can be studied by identifying the tourist's underlying needs for using technology, emerging expectations based on those needs (Rauschnabel, 2018b), and fulfilling expectations after using that technology (Palmgreen & Rayburn, 1979, 1985). Several scholars have also professed the method of studying pre and post media usage as a suitable way to measure attitudinal change, beliefs, satisfaction, behavioural intention, and behaviour (Bae, 2018; Bhattacherjee & Premkumar, 2004; Rokito et al., 2019). The tourism literature has investigated consumer behaviour through pre and post VR usage (Chiao et al., 2018; Hopf et al., 2020; Wen & Leung, 2021) but does not compare the gratifications for using multi-sensory VR and fulfilment of those gratifications. Thus, a better understanding of tourists' needs and a comparison of gratifications and fulfilment after using multi-sensory VR is needed. In simple words, is VR capable enough to meet the user's expectations or not? This research is of substantial importance for tourism marketers and VR content creators to get deep insights into the gratifications of a tourist from VR and whether those gratifications are being fulfilled or not. Managers can use the results from this research to create VR content that the tourists demand to keep them using the VR and purchasing it.

The different research models are used in U&G literature to study consumer behaviour. Still, the literature is unable to highlight the best model to measure the consequences of media consumption by comparing the different frameworks through strong statistical analysis, including SEM. Comparing different frameworks will suggest one best suitable model to study consumer behaviour, which should be used further by the researchers and avoid other models. It will ultimately save the time, cost, and energy of the researchers.

CHAPTER 3: CONCEPTUAL FRAMEWORK & HYPOTHESIS DEVELOPMENT

3.1 Introduction

The preceding chapter thoroughly discussed the literature published in the context of U&G theory, GO-GS approach, virtual reality, VR in tourism, and competing theories. The literature reviewed on these topics identified different research gaps that are very important to address and demands further investigation. U&G theory provides a theoretical lens through which behavioural intention linkages and interactions with other constructs are discussed. Then presented is the pertinent academic literature on newly proposed gratifications, pleasantness of experience, reuse, and purchase intentions.

This chapter has two main sections. Section 3.2 aims to provide a comprehensive explanation of seven different models that are compared to identify the best model for predicting visitors' pleasant experience (structural analysis 1). The gratifications obtained model is discussed in section 3.3 to study pleasantness of experience as a mediator, and reuse and purchase intentions as dependent variables (structural analysis 2). Hypotheses development and conceptual model for analysis 2 are also discussed in section 3.3.

3.2 Quantitative research (structural analysis 1)

The second main objective of this research is to study the gratifications sought and gratifications obtained, along with the comparison of different gratification models to highlight the best suitable model to study behavioural outcomes (objective four). The core variable of interest is an overall evaluation of VR exhibits in terms of pleasantness of experience. This construct covers the subjective (i.e. affective) assessment of an experience and is studied with tourism (Angelino et al., 2021), dining (Horng & Hsu,

2021), shopping (Kaltcheva & Weitz, 2006; Lunardo & Mbengue, 2009), gaming (Seppälä et al., 2016), and others. Pleasantness of experience in the current study evaluates the VR experience after usage. It broadly explains the VR experience as satisfying, pleasing, relaxing, and happiness (see Van Kerrebroeck et al., 2017a). Prior research has shown that pleasantness of experience relates to numerous managerially relevant behavioural consequences. Following the work of Kaltcheva and Weitz (2006) on how an environment translated into pleasant experiences, this research proposes that a virtual environment is associated with arousal, which drives the pleasantness of an experience, and ultimately translates into behaviours. The literature determined the relevance of this construct in immersive media (Loureiro et al., 2021; Van Kerrebroeck et al., 2017a). According to research objective number four, there is a need to compare different gratification models. Therefore, the succeeding sub-section presents different models and provides justifications to study them. The control variables are same for all models, but independent variables are changed. A total of seven models are studied in this research that are primarily derived from U&G theory.

3.2.1 Model zero

As discussed earlier, control variables are constant in all research models. Therefore, model zero provided the basic explanatory power. The control variables were age, gender, last educational degree, and VR familiarity. All of the other models were compared according to the improvement in explanatory power, i.e. coefficient of determination (R^2) recommended by Saunders et al. (2012) and a very recent approach suggested by Sharma et al. (2019). The R^2 values range from 0 to 1. A higher value close to 1 shows a greater explanatory power. The researchers categorised R^2 values as 0.25, 0.50, and 0.75, representing weak, moderate, and substantial explanatory power. R^2 values of 0.90 and higher typically overfit (Hair, Ringle, et al., 2011; Henseler et al., 2009). Contrary, Sharma et al. (2019) argued that R^2 is not

enough to compare the models. *"Instead, model selection criteria – in particular, the Bayesian information criterion (BIC) and the Geweke-Meese criterion (GM) – should be used due to their high model selection accuracy and ease of use"* (p. 346). They further argued that *"these criteria allow researchers to compare alternative models and select a parsimonious yet well-fitting model"* (p. 346) to identify the best model after comparing the competing models.

3.2.2 Model 1

The first proposed model has gratifications sought ∑(GS) as independent variables, and the dependent variable is pleasantness of experience (see figure 3.1). As highlighted by several researchers that GS is not always obtained by the users (Palmgreen & Rayburn, 1979, 1985). Therefore, this model is proposed to investigate the influence of users' expectations on the pleasantness of experience. It is possible that users having expectations can report pleasant experience despite whether the gratifications are fulfilled or not.

The abbreviations of variables are used in the equation: ENT, EDU, NOV, and TP for entertainment, education, novelty, and telepresence, respectively. b_0 indicates the constant, b_i · represents the independent variables regression coefficients.

Model 1: $\text{Pleasantness} = b_0 + \sum_{i=1}^{I} b_i \cdot (Grat_{i,sought})$

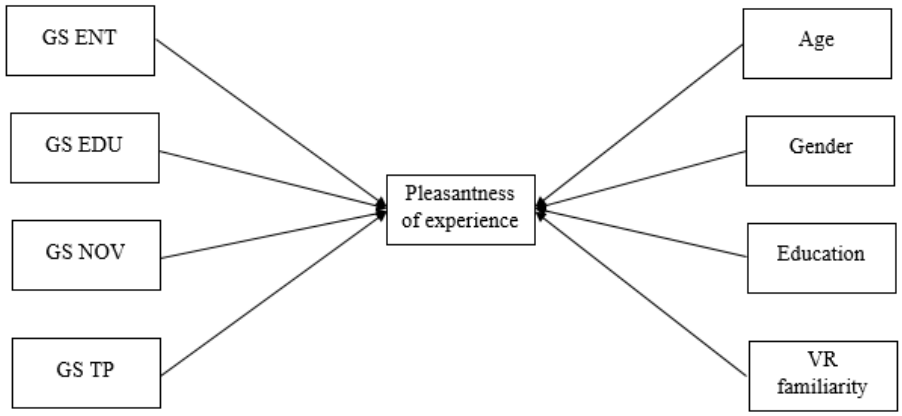

Figure 3.1: Proposed model 1 for analysis 1

Note: GS, gratifications sought; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

3.2.3 Model 2

The proposed model 2 is only different from the previous model regarding independent variables (see figure 3.2). The independent variables of model 2 are gratifications obtained ∑(GO). Most of the studies in U&G literature are conducted by using the gratifications obtained approach. Because the degree to which the user actually obtains gratifications after using a media contributes to the user's positive and satisfying experience (Palmgreen & Rayburn, 1985). Rather than incorporating GS or the user's personal importance, model two is quite simplistic and focuses on GO only.

Model 2: $\text{Pleasantness} = b_0 + \sum_{i=1}^{I} b_i \cdot (Grat_{i,obtained})$

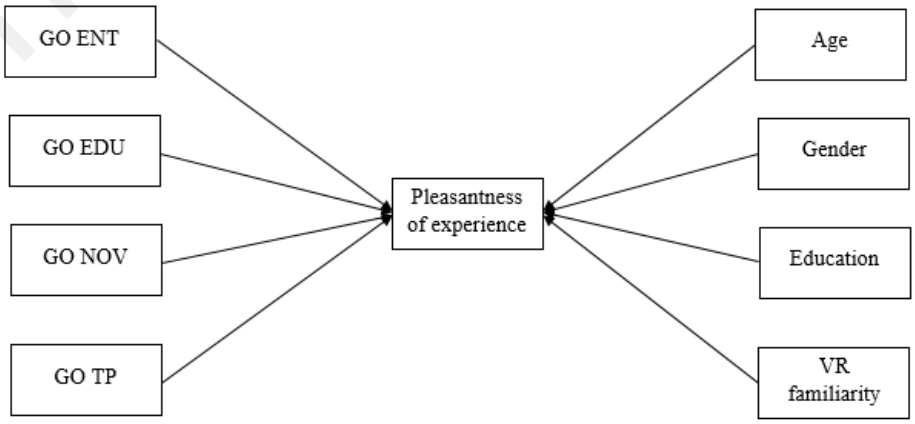

Figure 3.2: Proposed model 2 for analysis 1

Note: GO, gratifications obtained; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

3.2.4 Model 3

The proposed third model is the simplified discrepancy model ∑(GO - GS). This model depicts three possibilities after using media, i.e., fulfil GS, over-fulfil GS or under-fulfil GS. The technological medium must fulfil GS (GO=GS), and it is ideal to over-fulfil GS in which GO is more in comparison to GS, i.e., GO > GS (Palmgreen & Rayburn, 1979). Over-fulfilment of GS results in adopting a medium, frequent usage, and more dependency. In contrast, under-fulfilment occurs when a medium cannot fulfil the GS and performs less than the expectations (Palmgreen & Rayburn, 1979; Wenner, 1986). The visual depiction of model 3 is given in figure 3.3. As argued by Wenner (1982), *"positive (greater than zero) scores would indicate levels of relative satisfaction (or over-obtention) and a negative discrepancy score would indicate relative deprivation (or under-satisfaction or obtention)"* (p. 11). In other words, if GO are equal to or higher than the GS, visitors should rate their experience more favourable. Practically, a regression model would include difference scores as independent variables. Thus, more formally:

Model 3: $\text{Pleasantness} = b_0 + \sum_{i=1}^{I} b_i \cdot (Grat_{i,obtained} - Grat_{i,sought})$

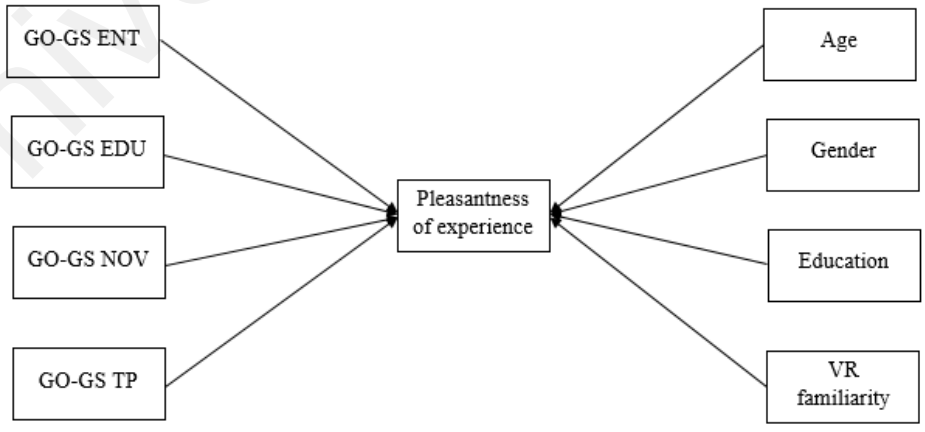

Figure 3.3: Proposed model 3 for analysis 1

Note: GS, gratifications sought; GO, gratifications obtained; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

3.2.5 Model 4

The preceding model does not include the user's personal importance for gratifications. All visitors do not shape their GO in the same way. For instance, consider two visitors; the first one is highly interested in learning about the topics shown in VR, whereas the second one is highly interested in getting entertained. Both might have similar GS of how entertaining the VR content is, but whether these GS are actually met will matter much more for the second visitor who has a strong wish to get entertained than for the education-focused visitor. The theoretical contribution of weighting pre-usage and post-usage assessments of VR experiences based on personal importance addresses a significant gap in the existing literature. Traditionally, studies have focused solely on capturing changes in user perceptions and evaluations before and after engaging with the technology. However, by considering the personal importance that individuals assign to specific aspects of the VR experience, this theoretical framework offers a more nuanced understanding of user assessments. By weighting the assessments according to personal importance, researchers can uncover the differential impact of VR on individuals' subjective evaluations and gauge the extent to which the VR experience meets their unique expectations and preferences. Hence, model 4 is based on adding a user's personal importance for each gratification into the equation, i.e. $\sum$ *j*(GO - GS). In practical terms, SEM would include difference scores as independent variables which are weighted based on a user *j*'s personal importance. Therefore, this model considers personal importance and the simplified discrepancy model (see figure 3.4).

Model 4: $\text{Pleasantness} = b_0 + \sum_{i=1}^{I} b_i \cdot w_{i,j} \cdot (Grat_{i,obtained} - Grat_{i,sought})$

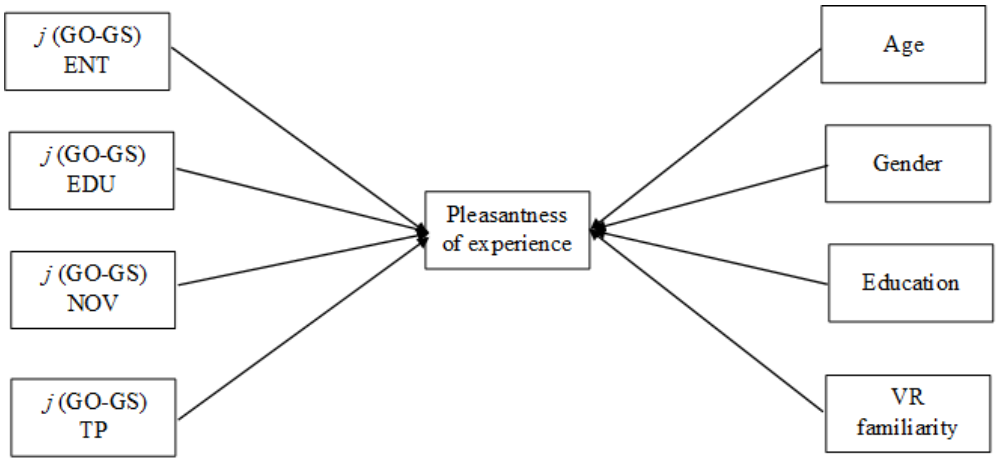

Figure 3.4: Proposed model 4 for analysis 1

Note: GS, gratifications sought; GO, gratifications obtained; *j*, user's personal importance; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

3.2.6 Model 5

The fifth model given in figure 3.5 is the transactional version of model 3. The fifth model has an addition sign between GS and GO rather than subtraction, such as ∑(GS+GO). Wenner (1986) mentioned two approaches, one was discrepancy approach and another was transactional approach. Wenner suggested not to rely solely on the GO-GS approach because it overlooks the unique contributions of both variables. Therefore, transactional model is also studied in this research.

Model 5: $\text{Pleasantness} = b_0 + \sum_{i=1}^{I} b_i \cdot (Grat_{i,sought} + Grat_{i,obtained})$

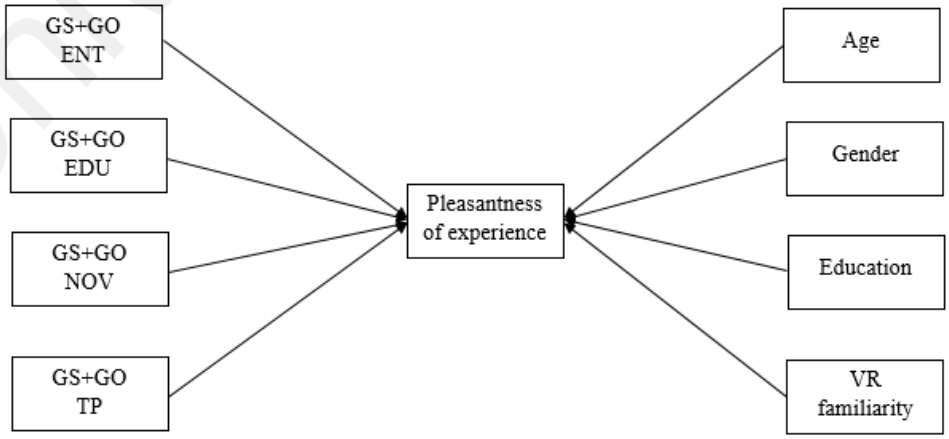

Figure 3.5: Proposed model 5 for analysis 1

Note: GS, gratifications sought; GO, gratifications obtained; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

3.2.7 Model 6

The sixth model given in figure 3.6 is also the transactional model, which is a transactional version of model 4. This model also has a sign of addition between GS and GO along with the user's personal importance $\sum j$(GS+GO). The objectives for using transactional model, and weighted by user's personal importance are discussed in sections 3.2.6 and 3.2.5, respectively.

Model 6: $\text{Pleasantness} = b_0 + \sum_{i=1}^{I} b_i \cdot w_{i,j} \cdot (Grat_{i,sought} + Grat_{i,obtained})$

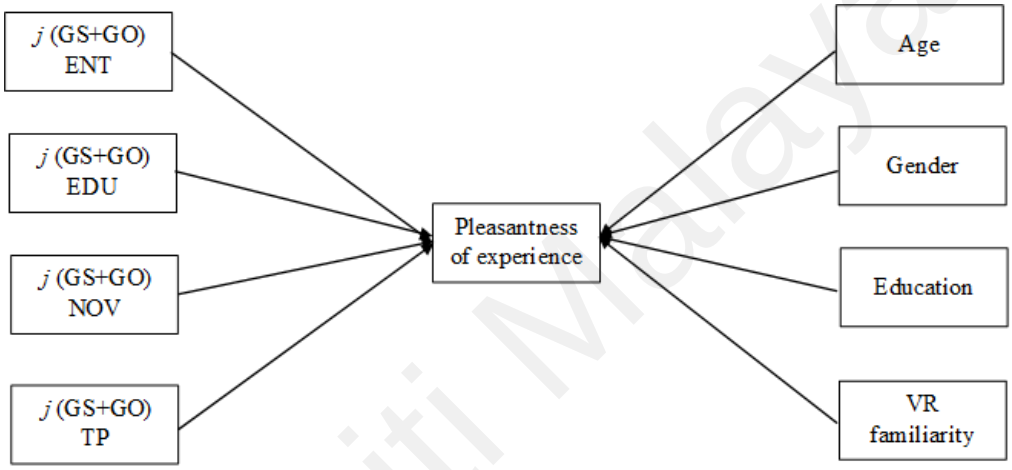

Figure 3.6: Proposed model 6 for analysis 1

Note: GS, gratifications sought; GO, gratifications obtained; *j*, user's personal importance; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

3.2.8 Model 7

The modified gratifications obtained model $\sum j$(GO) is also proposed by incorporating user's personal importance *j* with GO. Combining the idea of model 2 with the core assumption of model 3 leads to the last model (i.e., model 7). The visual depiction of model 7 is given in figure 3.7.

Model 7: $\text{Pleasantness} = b_0 + \sum_{i=1}^{I} b_i \cdot w_{i,j} \cdot (Grat_{i,obtained})$

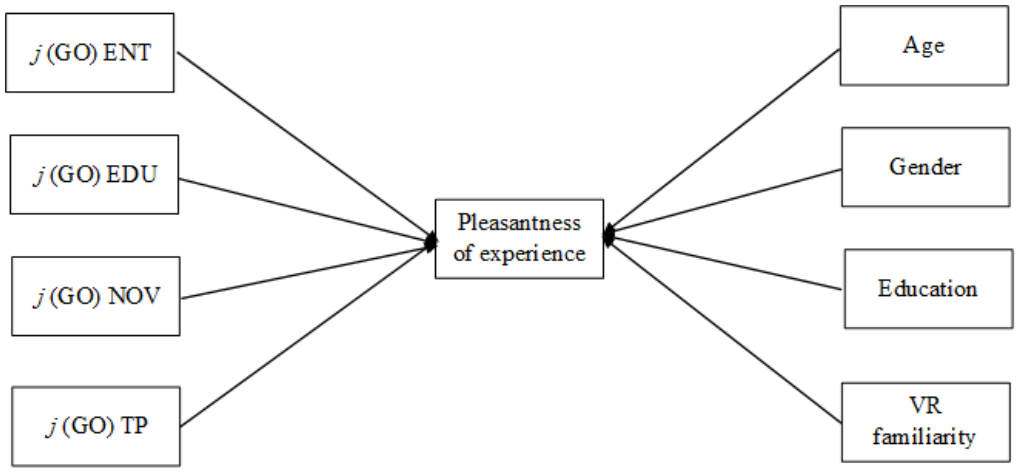

Figure 3.7: Proposed model 7 for analysis 1

Note: GO, gratifications obtained; *j*, user's personal importance; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

3.3 Quantitative research (structural analysis 2)

The development of hypotheses and conceptual framework for structural analysis two are discussed in this section. A detailed discussion of these variables is given in section 2.7.

3.3.1 Entertainment

Entertainment evokes emotional responses among audiences (Zillman & Bryant, 1994), and is considered a general activity that fulfils intrinsic motivations by providing an entertaining and enjoyable experience (Venkatesh, 2000). As mentioned above, researchers have investigated the role of VR rollercoaster in user's satisfaction and willingness to pay extra for VR experience (Jung et al., 2018), creating the offline museum visit intention (H. Lee et al., 2020), investigating the visitor experience and intention to revisit the museum (Jung et al., 2016). Despite the researchers' efforts, the role of entertainment in creating pleasantness of experience is still missing in the literature. Therefore, based on these arguments and emerging themes from interviews, this research postulates the following hypothesis:

H1: *Gratifications obtained for entertainment is positively related to pleasantness of experience*

3.3.2 Education

Education is the learning of new information and enhancing skills (Dewey, 1986). In tourism, education is considered as the absorption of events by a tourist to increase knowledge or skills through active participation at a destination (Oh et al., 2007; Pine & Gilmore, 1999). ICTs can help to boost tourism and offer value for e-learning in the tourism industry (Hajli & Lin, 2014) by providing a chance to collect information related to tourism destination (Buhalis & Law, 2008) and learn something new during tourism activities (Jung et al., 2016). Several ICTs are used in tourism to study the educational impact, for instance, websites, social media, AR, and VR. It is evident from the literature that VR provides education to tourist which directly influences visitor experience (Jung et al., 2016) and the positive impact on museum visit intention (H. Lee et al., 2020). Hence, it can be proposed that education will have an influence on pleasantness of experience:

H2: *Gratifications obtained for education is positively related to pleasantness of experience*

3.3.3 Novelty

Novelty is a motivation of a traveller to seek some unique and new activities (Bello & Etzel, 1985) that leads to a positive tourism experience and acts as an antecedent of memorable tourism experiences (Skavronskaya et al., 2019). Sundar and Limperos (2013) proposed novelty as a gratification to be studied with modern technologies and numerous researchers declared VR as a novel technology (Nagy &

Turner, 2019; Waycott et al., 2018). Despite the researchers' efforts, a study of VR's novelty is still missing in the literature – specifically in tourism – where extant literature has not investigated the role of novelty in forming positive experience (Mitas & Bastiaansen, 2018). To fill the void, this research proposes the following hypothesis:

H3: *Gratifications obtained for novelty is positively related to pleasantness of experience*

3.3.4 Telepresence

Telepresence is defined as a technological characteristic that generates a computer-mediated environment in which the user feels themselves in an artificial environment compared to the immediate real or physical environment (Steuer, 1992; Suh & Chang, 2006). Telepresence is widely studied with VR (Jung et al., 2016; D. Kim & Ko, 2019; Tussyadiah et al., 2018) and it is considered an important construct for VR related studies (Shahab et al., 2021). Because VR provides higher telepresence and creates a positive attitude towards tourism sites (Tussyadiah et al., 2018). VR leads to a positive visiting experience due to the telepresence (Jung et al., 2016) and telepresence leads to flow experience (D. Kim & Ko, 2019), which visitors find pleasant. Thus, the researcher hypothesizes the following:

H4: *Gratifications obtained for telepresence is positively related to pleasantness of experience*

3.3.5 Pleasantness of experience

It is a collection of positive and negative emotions, which deals with the outcomes of a product or service, for example, happy or unhappy, satisfied or unsatisfied, pleased or annoyed, relaxed or bored, and others (Van Kerrebroeck et al., 2017a). The positive customer experience, visiting experience, or technology experience leads to behavioural intentions, such as revisit intentions, reuse intentions, or purchase intentions (Jung et al., 2016; Nasermoadeli et al., 2013; So & Kim, 2013). Thus, the researcher hypothesizes:

> ***H5:*** *Pleasantness of experience from VR is positively related to (a) reuse intention and (b) purchase intention*

3.3.6 The mediating effect of pleasantness of experience

One of the reasons for studying pleasantness of experience as a mediator is the recommendation provided by Loureiro et al. (2019) after conducting a literature review of 150 research documents published in VR and marketing: *"previous studies tend to regard constructs such as pleasure, arousal, vividness and telepresence as mediators between stimuli and behavioural intentions. However, we suggest other mediators…"* (p. 12). The literature indicates that the constructs discussed earlier, such as entertainment, education, novelty, and telepresence have a relationship with a pleasant experience. Studies showed that visitors reported a pleasant experience when they got entertainment through VR. For example, Jung et al. (2016) found that entertainment significantly affects the visiting experience among the visitors of the Geevor Museum.

Thus, fulfilling the gratification of entertainment may provide visitors with a pleasant experience.

The extant literature has also suggested that education creates a positive experience, which leads to revisit intention and satisfaction with the tourism destination (Jung et al., 2016; Song et al., 2015). Tourists usually like to get an education while they are visiting a tourism destination. Yobelli et al. (2018) also highlighted that education through VR increases knowledge and positive experience.

People use the latest technology to get a unique and pleasurable experience (Domina et al., 2012). VR is a novel technology (Nagy & Turner, 2019) that may provide a pleasant experience to tourists (Mitas & Bastiaansen, 2018) because tourists also demand new activities at tourism destinations (T. H. Lee & Crompton, 1992). Hence, VR can be regarded as one of the critical factors determining the pleasantness of experience through novelty. Moreover, according to Suh and Chang (2006), people use media to forget about their immediate surroundings by visiting a virtual world. Highly immersive media provides more telepresence, leading to a positive experience, attitudinal change, and behavioural intention (Tussyadiah et al., 2018; W. Wei et al., 2019). Studies showed that VR through telepresence provides a positive visiting and flow experience (Jung et al., 2016; D. Kim & Ko, 2019).

Sheeran et al. (2017) found that experience has a paradoxical impact on intention-behaviour consistency. The greater positive experience strengthens the behavioural intention to perform a specific behaviour. A meta-analysis conducted by Glasman and Albarracín (2006) concluded that experience also affects attitude-behaviour formation. Therefore, visitors with a positive visiting experience through VR prefer to revisit the tourism destination (Jung et al., 2016). The positive customer experience through technology leads to reuse and purchase intentions (So & Kim, 2013). Therefore, it is highly likely that pleasantness of experience mediates the

relationship between gratifications obtained and behavioural intentions, a likelihood that may be hypothesised as follows:

> ***H6:*** *Pleasantness of experience from VR positively mediates the relationship between (a) entertainment, (b) education, (c) novelty, (d) telepresence and reuse intention*
>
> ***H7:*** *Pleasantness of experience from VR positively mediates the relationship between (a) entertainment, (b) education, (c) novelty, (d) telepresence and purchase intention*

3.3.7 Reuse & purchase intentions

Reuse intention is the visitors' intention to use multi-sensory VR at tourism destinations. It plays a vital role in predicting consumer behaviour (H. B. Kim et al., 2009; So & Kim, 2013). Contrary, purchase intention is the willingness of a tourist to purchase VR for personal usage. As discussed earlier, the main objective of structural analysis two is investigating the two critical outcomes that are reuse of VR at tourism destinations and purchase intention of VR. The literature of digital marketing provides support for these outcomes, such as Masri et al. (2021) found that *"consequence factors of customer trust online vendor consist of customer intention to purchase and reuse the online vendor"* (p. 13). Choi and Sun (2016) also stated that *"reuse intention is positively related to the final purchase"* (p. 4). Both reuse and purchase intentions are broadly characterised as behavioural intentions (BI) (So & Kim, 2013). It is also empirically proven in the literature that technology users who gets a positive

experience from the technology usually want to reuse the technology or purchase it (H. B. Kim et al., 2009; S.-H. Kim, 2010), and these intentions also influence each other (Y.-T. Chang et al., 2015). Hence, the researcher hypothesizes:

H8: *Reuse intention is positively related to purchase intention*

The following model in figure 3.8 is proposed based on the discussion mentioned above. Four constructs are independent variables that are entertainment, education, novelty, and telepresence. Two constructs are dependent variables such as reuse intention and purchase intention. Pleasantness of experience is proposed as a mediator between all four independent and dependent variables. Control variables are age, gender, education, and VR familiarity. They play a crucial role in forming a robust conceptual framework. These four variables are carefully selected and incorporated into this research to mitigate the impact of potential confounders. This will help to increase the internal validity and reliability of the results, leading to more accurate and valid conclusions.

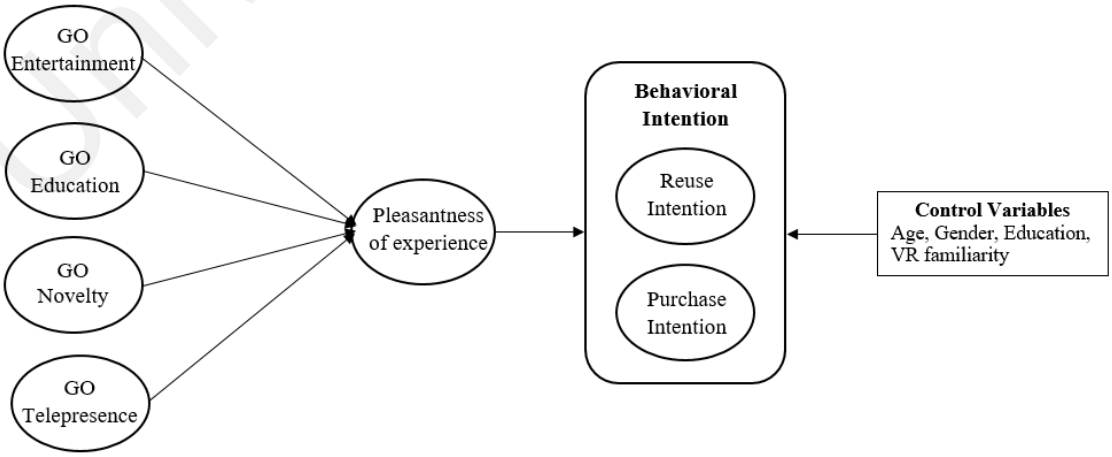

Figure 3.8: Proposed conceptual model for analysis 2

Note: GO, gratifications obtained

3.4 Summary

Seven proposed models are primarily derived from U&G theory and are discussed in this chapter. These models aim to study GS and GO and compare different gratification models to highlight the best suitable model to study behavioural outcomes. Section 3.3 explains the main conceptual framework for analysis 2 and hypotheses development. The succeeding chapter describes the research methodology along with the reasons for conducting research at Deutsches Museum Munich, Germany, interviews and quantitative data collection and analysis.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Introduction

This chapter explains the research methodology used in the current study. This chapter is divided into five different sections. The first section provides the SLR methodologies for U&G theory, gratification discrepancies approach, and VR in tourism that are discussed in chapter two. The second section discusses the reasons for selecting Deutsches Museum for this research. The third section presents an overview of the research paradigms existing in the literature, the justifications for conducting interviews, and the output from those interviews. The fourth section explains the quantitative data collection process: sampling frame, sampling method, and determination of sample size. Fifth section discusses the operationalisation of constructs used in this research, the pilot study for testing these constructs, the back-translation method for using both English and German language questionnaires, questionnaire development, and the suitable data analysis.

4.2 SLR methodologies

A systematic literature review (SLR) approach has been adopted to identify research gaps by discussing the extant research and providing future research agenda (Hao et al., 2019; Kumar et al., 2019). Paul and Criado (2020) provided a list of different types of literature reviews. For instance, bibliometric review mainly focuses on figuring out trends and citations and/or co-citations for any specific research problem, method, theory, country, author, and journal (Paul & Criado, 2020), e.g., bibliometric analysis in the context of international business (Rialp et al., 2019). Framework based review deals with the usage of a specific framework to conduct reviews, for example, ADO (antecedents, decisions, and outcome) framework (Paul & Benito, 2018) or TCCM (theory, construct, characteristics and methodology) framework (Paul & Rosado-Serrano, 2019). Structured review deals with widely used

theories, constructs, and methodology (Rosado-Serrano et al., 2018). A meta-analysis review provides detailed information about the findings and statistical tools used in previous research (Knoll & Matthes, 2017). A hybrid review integrates a framework to provide future research agenda (Kumar et al., 2019). Theory-based review deals with a specific theory in a particular domain or research area (Gilal et al., 2019). The following sub-section discusses three SLR methodologies for U&G theory, gratification discrepancies approach, and VR in tourism.

4.2.1 SLR methodology for U&G theory

This sub-section has employed theory-based review according to the guidelines presented by Paul and Criado (2020) and other classical theory-based reviews (Gilal et al., 2019; Kozlenkova et al., 2014; Paul & Rosado-Serrano, 2019). The following research string was used to search articles from different databases that have the below-mentioned key terms in their title, abstract, and keywords:

(Uses and gratifications OR UGT OR U&G theory)

The results have shown a wide range of research papers that are discussed in 2.2.4 section.

4.2.2 SLR methodology for gratification discrepancies approach

This sub-section uses a theory-based review by adopting the research methodology from present research (Gilal et al., 2019; Paul & Rosado-Serrano, 2019) to review a specific theory and extend its application with new technologies (Shahab et al., 2021). All databases were searched to retrieve the maximum literature, for instance, Emerald, SAGE, Taylor & Francis, Science Direct, Wiley, and Google Scholar.

There are two ways to search the databases: (i) through different keywords or (ii) through research string using Boolean operators. The use of keywords is a traditional way, whereas using a research string having Boolean operators is a novel

way (Boland et al., 2017). Therefore, the research string was developed by using the Boolean operators (Boland et al., 2017) that had these specific key terms in either of their title, abstract, or keywords:

(gratificatio* sought) AND (gratificatio* obtained) AND (gratification discrepanc*)

In this string, the word "AND" indicates that all three terms must be available in the text. In contrast, the symbol "*" denotes that multiple terms can be searched with the same stem, such as "gratification" AND "gratifications" or "discrepancy" AND "discrepancies". Palmgreen and Rayburn introduced the GO-GS approach in 1979; hence, the time frame of 1979 to 2022 was selected to search the databases. In order to increase the efficiency of the search process, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework was adopted (Moher et al., 2010), which is presented in figure 4.1.

The search across all databases provided 4,176 research articles, and a careful search of google scholar presented eight more research articles. Therefore, a total of 4,184 articles were considered for the initial screening. The initial screening of these articles was conducted based on the following criteria:

(i) Articles published in peer-reviewed journals

(ii) Articles having (gratificatio* sought), (gratificatio* obtained) and (gratification discrepanc*) key terms in the article's title, abstract, or keywords

After an extensive screening of these articles only 29 met the initial screening criteria, excluding 4,155 articles. The primary reason for exclusion was that most articles did not study the GO-GS approach.

The remaining 29 articles were evaluated comprehensively by applying the succeeding criteria:

(i) Articles published in a peer-reviewed journal

(ii) Articles are written in the English language

(iii) Articles used the GO-GS approach

(iv) Articles using a quantitative research design

A total of 06 articles were further removed and only 23 research articles met the outlined criteria. These articles are discussed in section 2.3.1.

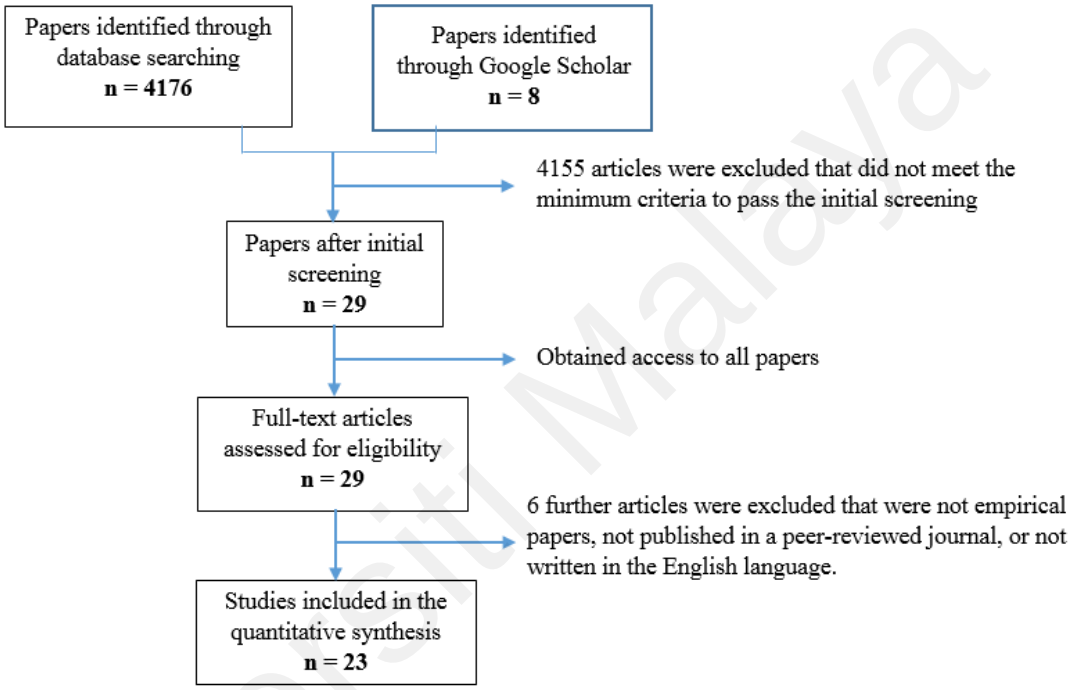

Figure 4.1: PRISMA Framework for GO-GS discrepancies approach

4.2.3 SLR methodology for VR in tourism

This sub-section provides SLR methodology of the literature published in the context of VR and tourism (refer to section 2.6.1). The methodology was adopted from extant research (Gilal et al., 2019; Paul & Rosado-Serrano, 2019; Paul & Criado, 2020) to search databases for retrieving all the relevant research documents. The research articles published in the context of VR and tourism are very limited. Therefore, research articles published in blind peer-reviewed journals were taken by following Teng et al. (2014) and conference papers published in the form of a book (Boland et al., 2017).

The research string was developed by using Boolean operators to search research documents from databases that have the below-mentioned key terms anywhere in their text:

(virtual reality OR VR) AND (tourism OR travel)

In this string, OR denotes that one of the terms must be available, either "virtual reality" OR "VR". AND indicates that both of the terms can be searched, for example, articles having "virtual reality" AND "tourism" in their text. The time period was selected from 1995 to 2022. A total of 29,824 research documents were generated from the databases (see figure 4.2).

The initial screening of all research documents was conducted by applying the following criteria in articles' title, abstract, and keywords:

1. Research documents having (a) virtual reality OR VR (b) tourism OR travel.
2. Empirical research document.
3. Published in a blind peer-reviewed journal or book.
4. Written in the English language.

After initial screening, all research documents were analysed thoroughly based on the following eligibility criteria:

1. Research documents exploring the impact of VR in the tourism context.
2. The quantitative research design was used and described in the methodology section.
3. A link between the variables/stimuli was hypothesised and tested.

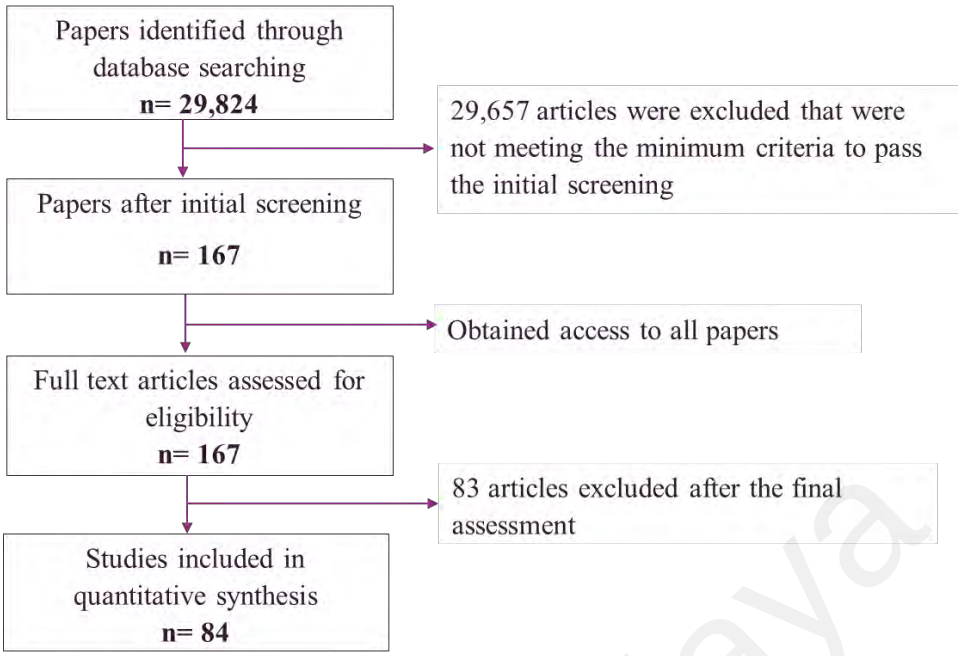

Figure 4.2: PRISMA Framework of research documents published in the context of VR & tourism

4.3 Deutsches Museum

Virtual reality is able to provide a multi-sensory experience in a computerised environment by allowing visualising the computer-generated world, auditory feeling, smell, taste, walk & touch. Multi-sensory experience in a virtual environment does not necessarily deal with all of them, but it also depends on more than one sense (Fuchs & Reichel, 2006; Guttentag, 2010). Research on multi-sensory VR experience in tourism is still missing in the literature (except Flavián et al., 2019, 2021b; Hopf et al., 2020; Wen & Leung, 2021). Therefore, this research was conducted in the VRlab of Deutsches Museum, Munich that provides a multi-sensory VR experience to visitors. It is the world's largest (66,000 square metres) science and technology museum with its priceless collection of historical artefacts. A few of these historical artefacts are the first electric dynamo created by Siemens-1866, the first car manufactured by Benz-1886, and the laboratory equipment that was used to split the first atom-1938. It was established in 1903, making it one of the world's oldest and most visited museums (Deutsches Museum, 2020a; New York Times, 2012).

Deutsches Museum provides free of cost multi-sensory VR experience as part of the museum4punkt0 project. Museum4punkt0 is a collaborative initiative in Germany that aims to introduce innovative methods for digitally transforming museums. People from research institutions and technology providers work closely with each other to enhance visitor experience and increase access to cultural heritage by using the Internet of Things (IoT), artificial intelligence (AI), AR, and VR.

Figure 4.3 shows visitors' interest in VR, where visitors are waiting for their turn at the entrance of the VRlab. The geographical area of the VRlab is 120 square meters and it has three VR areas: one is a driving simulator in which the tourist can drive a lunar roving vehicle and two other VR areas that provide a detailed experience of the world's first Sulzer steam engine, first automobile, first glider and first landing on the moon with the lunar rover (Deutsches Museum, 2020b). The left side of figure 4.4 depicts the VR area, and the right shows the driving simulator. While using VR area the visitors can *"go where the steam circulates in the Sulzer steam engine, dispatch Otto Lilienthal on a test flight with his famous glider, or take a seat in the simulator to drive the Lunar Roving Vehicle across the lunar surface"* (Deutsches Museum, 2020b).

Deutsches Museum shows a fully immersive and interactive VR experience through the Oculus Rift headset and HTC controller to navigate freely in the virtual world. The 6DoF-rotational and transversal motions are tracked through the two oculus sensors that are attached to the computer workstation to allow users to see up and down, freely move left and right or backward and forward, roll (longitudinal axis), yaw (normal axis) and pitch (transverse axis). All of the user's movements are reflected in the virtual environment and also shown on a giant LED screen. The friends and family members can also see the VR content that a user is experiencing (see figure 4.5, in which content is shown on the LED). One tourist is given 15 minutes to use the VR

area in which a staff from the VRlab briefs them about the safety, precautions, use of VR and continuously guides them during the VR experience. The data for this research was collected two times from the visitors who had experienced the VR area.

Figure 4.3: Visitors waiting for their turn to use VR

Figure 4.4: Left (VR area), Right (driving simulator)

Figure 4.5: VR area[1]

VR experience begins with a scene where a user is surrounded by four different VR worlds: a steam engine, automobile, glider, and landing on the moon. By using an HTC controller, the user can select any VR world of their choice. Each of the four VR worlds offers an immersive audio-visual encounter, allowing users to seamlessly navigate diverse locations within the virtual realm. The users possess the liberty to ambulate towards virtual content or opt to assume a stationary position for observation, thereby engaging the senses of walking, audio and visual perception.

4.3 Research paradigm positioning

Philosophical views remain associated with research endeavours, and researchers use them as guidelines whenever they conduct a research project (Creswell & Clark, 2017). The researchers have to show their philosophical beliefs for the nature of the study. Researchers' views towards the world usually have an impact on the

[1] Source: (Deutsches Museum Digital, image by Konrad Rainer, cc-by-SA 4.0)

research phenomena and research topics, data collection, and the understanding of research outcomes or results (Cooper & Schindler, 2006). These beliefs help the researchers explain why choosing a quantitative, qualitative, or mixed-method (Creswell & Clark, 2017). Creswell and Clark (2017, p.6) termed worldviews as *"a basic set of beliefs that guide action"*. Contrary, other researchers characterised it as a research paradigm having ontology, epistemology, and methodology (Lincoln & Guba, 2000). The main differences in research paradigms are also given in table 4.1.

Two primary research philosophical paradigms are dominantly used in the social sciences literature: positivism and interpretivist (L. A. Hudson & Ozanne, 1988; Lincoln & Guba, 2000). Both differ from each other in terms of ontology, epistemology, and methodology (Carson et al., 2001). The concept of ontology is defined as the nature or existence of reality, epistemology is a relationship between reality and the researcher, and methodology is a process of understanding reality (Carson et al., 2001). In simple words, ontology explains *what is knowledge*, epistemology is *how do we come to know about the knowledge* and methodology is *the process to study* (Creswell, 2014).

Principally, the positivism research paradigm simplifies reality (Bryman, 2012), which is a traditional form of the scientific method and is also known as empirical science, positivist/post-positivist research, and post-positivism (Creswell, 2014). The positivism paradigm demands a quantitative research design to study reality (Crossan, 2003). The researcher has to treat reality 'objectively', which means that the researchers have to keep themselves independent from the reality being studied (Carson et al., 2001). This paradigm provide results that can be generalised to the population. Therefore, the deductive approach is used to propose the hypothesis that must be analysed through statistical tests (Bryman, 2012; Guba & Lincoln, 1994). Usually, positivist researchers view reality as singular by incorporating a theory to explain the

single reality. It also helps extend the theory to diverse research areas, studying the existing research gaps by collecting the data through questionnaire and using research design according to the proposed hypothesis (Gioia & Pitre, 1990). Ghazali (2011) also stated the same in context of marketing: *"historically, the approach utilised by marketing and consumer behaviour researchers was grounded in the positivist paradigm… to study causal relationships between independent and dependent variables with methods used being driven by quantitative techniques… it leans more towards a deductive and quantitative methodology, in line with the dominant trend in this area"* (p. 131).

The second research paradigm is interpretivist that reflects reality (Bryman, 2012), which is also known as the social constructivist research paradigm (Mertens, 1998). This paradigm provides detailed knowledge about a specific phenomenon (Weber, 1981). These niceties are more detailed as compared to the positivism paradigm. The interpretivist paradigm demands qualitative research design through interviews or focus groups (multiple respondents) to explain naturally occurring phenomena in the social world (Bryman, 2012; Maanen, 1979). It explains the how and why of reality by considering the context and complexity of the phenomenon (Bryman, 2012). The researcher has to treat reality 'subjectively' by interacting with the participants through open-ended and broad questions (Creswell & Clark, 2017). It does not start with an existing theory. Instead, the theory is developed from more general themes to understand reality, incorporating the bottom-up inductive method (Guba & Lincoln, 1994). Hence, the interpretivist paradigm has less generalisability (Bryman, 2012). Carson et al. (2001) also highlighted the importance of the interpretivist paradigm in context of marketing because this paradigm interrogates consumer behaviour phenomenon by explaining the existing patterns (Yin, 2014).

Some social scientists believe that both positivism and interpretivist paradigms should be used together to better understand reality (Teddlie & Tashakkori, 2003). This paradigm is known as the pragmatic research paradigm or mixed-method. The mixed-method is a pluralistic approach based on the research question because it provides insights about the existing problem and outcomes of research to address that problem (Creswell, 2014). The pluralistic approach is the use of both positivism and interpretivist paradigms. The positivist view explains that a theory can explain the phenomena, whereas the interpretivist view helps collect the opinions of different individuals to understand the nature of the phenomena (Ashraf, 2016).

After discussing the various research paradigms, it is concluded that this research uses a pragmatic research paradigm or mixed-method. Firstly, interviews were conducted to get in-depth details from visitors (i.e. needs) for using multi-sensory VR (interpretivist). Afterwards, hypotheses were postulated according to the conceptual model, and the data were collected through a questionnaire (positivism).

Table 4.1: Contrasting dimensions of positivism, interpretivist, and mixed-method

Dimensions	Positivism	Interpretivist	Mixed / pragmatism
Methods	Quantitative method	Qualitative method	Mix methods
Research questions	Quantitative research question, research hypothesis	Qualitative research question	Multi-method research questions including quantitative and qualitative
Purpose of research	Often confirmatory plus exploratory	Often exploratory plus confirmatory	Both confirmatory and exploratory
Form of data	Typically numerical	Typically narrative	Both numerical and narrative
Role of theory logic	Rooted in conceptual framework or theory, hypothetico-deductive approach	Grounded theory, inductive approach	Both deductive and inductive
Typical studies or design	Correlational, survey, or experimentation research design	Ethnographic research design	Multi-method research design, parallel and sequential
Data analysis	Statistical analysis: descriptive and inferential	Thematic strategies: categorical and contextualization	Integration of statistical and thematic data analysis

Source: Tashakkori & Teddlie (2009)

4.4 Interviews

Several gratifications are being used in the literature according to the nature of a technological medium (see Table 2.1 and section 2.2). For example, social media fulfils social needs. Hence, people seeking socialisation will prefer to use social media (Basilisco & Jin, 2015; Ha et al., 2015; Korhan & Ersoy, 2016). In the same way, Ghazali et al. (2019a, 2019b) studied gratifications (challenge, achievement, social interaction, escapism) for playing AR Pokémon games and found that challenge, achievement, and social interaction positively influence enjoyment that ultimately affects continuance intention to play and purchase intention. Rauschnabel et al. (2017) also highlighted several gratifications for playing AR Pokémon games, such as nostalgia, enjoyment, physical activity, flow, and image improvement. Due to the customised multi-sensory VR experience of the Deutsches Museum, a total of 11 face to face interviews were conducted from the visitors to identify the gratifications for using VR in order to develop the conceptual model. This technique has been adapted from Furst et al. (1996) and S. Hudson et al. (2019) because it is considered helpful in such types of research. The interviews were conducted from those visitors who had used a VR area (not a driving simulator) for 15 minutes, experienced all four VR contents, were more than 18 years of age, and were able to communicate in English.

The interviewees were asked about their motivations for using VR, and their responses were transcribed afterwards. The data collected from interviews were imported into NVivo 12, allowing for systematic coding and exploration of the data from a theoretical point of view. To generate themes, the data were reviewed line by line, and initial codes were assigned to capture important concepts and ideas. These codes were then grouped and organised into broader themes based on their relevance and connections. The different abstract ideas were characterised as the main construct. For example, words such as entertaining and fun represent a construct *entertainment*.

Other words like education, learning, and getting information denoted the construct *education*. The profiles of the interviewees are given in Table 4.2. In order to protect interviewees' identity, names represent pseudonyms, and the age is categorised in decades. The results were then discussed with four experts (Two professors of digital marketing, a practitioner, and a new media scholar) to get their insights on the emerging themes. Two experts were full professors of digital marketing working at a German university. Third expert was a PhD scholar specialising in digital marketing with a strong research profile in XR technology. Fourth was a practitioner who holds a PhD degree and currently serves as the head of the VR lab. Table 4.3 provides the interviewees' quotes and figure 4.6 shows the detailed emerging themes from interviews.

4.4.1 Entertainment

Many of the respondents mentioned the entertaining experience of VR. It is also empirically evident from the literature that VR rollercoasters provide an entertaining experience (Jung et al., 2018) and entertainment to museum visitors (Jung et al., 2016; H. Lee et al., 2020). Alan, a businessman, stated that "virtual reality is entertaining, and interesting how it captures our movement". Virtual reality at the Deutsches Museum is 6-DoF that reflects all of the user's movements in the virtual environment, allowing users to see up and down, freely move left and right or backward and forward, roll (longitudinal axis), yaw (normal axis) and pitch (transverse axis). Hence, Alan reported, "how it captures our movement".

Katrine, a university student, highlighted the fully immersive and interactive VR experience at the Deutsches Museum by commenting that "I totally indulged in the view… it is entertaining but the time was limited". Katrine mentioned three different situations: (i) indulging experience, (ii) entertaining, and (iii) the time was limited. The first two situations can be supported by the pedagogical research conducted by H. Lee

et al. (2020), where Lee and colleagues concluded that the VR experience is immersive and entertaining. The average length of first-time users of VR is 16 minutes (Vailshery, 2021). Therefore, Deutsches Museum allows 15 minutes to every user. The reason for mentioning a limited time can be understood with the help of the time compression concept. Recently, researchers found that VR users feel a longer actual duration is compressed into a shorter perceived experience (Mullen & Davidenko, 2021). Consequently, reporting the limited time is justifiable.

Diana, a grocery store in charge, stated the fun of using VR and the other emotions by saying, "the adventure is real, feeling is very good and it's fun to use". The properly designed VR content can be considered beneficial in convincing users that the virtual environment is real (Penn & Hout, 2018). VR content at the Deutsches Museum is a multi-sensory experience that the users consider real. Another respondent, Martin, a factory worker, mentioned that VR experience "was really fun and cool".

As discussed earlier, one of the VR contents at the Deutsches Museum is Apollo 17 mission. This mission was the last mission of Apollo's NASA in which a lunar rover – for the first time – was driven on the moon. VR content showed details of the crew members, spacecraft properties, lunar landing, lunar rover, and the feeling of walking on the moon. Furthermore, it also provided a chance to play golf on the moon – where gravity is shallow. Consequently, Paul, a banking officer, mentioned getting fun from one of the specific content "playing golf on the moon was really fun".

4.4.2 Education

According to several respondents, another important motivation for using VR is education. Education as a construct is empirically studied in the literature. Researchers concluded that VR provided education to form a positive visitor experience (Jung et al., 2016) and intention to visit a museum (H. Lee et al., 2020). Deutsches Museum is the

world's largest (66,000 square metres) science and technology museum with its priceless collection of historical artefacts. It was established in 1903, making it one of the world's oldest and most visited museums (Deutsches Museum, 2020a; New York Times, 2012). Therefore, the VR experience at the Deutsches Museum helps to provide education along with entertainment. Lara, a teacher, stated that VR "is a good way to provide education and learning. I also learned about landing on the moon, steam engine, Benz car, and first glider". Pedagogical research also supports the capacity of VR to provide education in the context of museums (Zouboula et al., 2008).

George, a marketing manager, highlighted the VR role through its content to enlighten users' minds by mentioning that "I got education related to the inventions of classical technologies". These classical technologies are considered pioneers in their fields to open the doors for upcoming latest technologies. For instance, automobiles nowadays are still functioning on the basic initial principles introduced during the development of the first automobile. In the same way, Otto Lilienthal's gliding set the basics for airline industries and others. Thus, George mentioned getting education through VR – the same is argued by Jung et al. (2016) that the users like to experience VR content of past events.

In line with the literature, Katrine, a university student, also mentioned the importance of education along with entertainment by mentioning that VR "content is good to get new information and education, not only entertainment". The extant literature supports this phenomenon of edutainment (Jung et al., 2016; H. Lee et al., 2020). Joseph revealed the importance of getting information through the mediated environment by stating, "to get new information to the brain, not the real but artificial and to the nearest point". Fabian, a university student, explained it further by mentioning about the new experience for learning purposes that VR "is a new experience to see the working of a steam engine, every part is moving, and also for a

learning purpose". As explained previously, multi-sensory 6-DoF VR provides autonomy to move in all directions, including left and right or backward and forward, roll (longitudinal axis), yaw (normal axis), and pitch (transverse axis). In this 6-DoF VR, users could navigate freely in the virtual world, which gave them a feeling of experiencing everything closely. Furthermore, Danny, a shop owner, commented on the working of a VR and getting information by mentioning, "to learn something about virtual reality, how it works and of course to get some information about the topics moon landing and the flight shown of Otto Lilienthal. It was quite interesting".

4.4.3 Novelty

Novelty is defined as a situation that is not previously encountered or experienced by a person (Barto et al., 2013). Novelty attracts a person's attention by giving a chance to feel a different or unique scenario, and tourist also wants to have a novelty (T. H. Lee & Crompton, 1992). Sundar and Limperos (2013) have proposed novelty as a gratification to be studied with modern technologies, whereas numerous researchers have declared VR as a novel technology (Nagy & Turner, 2019; Waycott et al., 2018). The informant Lara, a school teacher, mentioned the same, "we are on a recreational tour, and my students were interested in using VR, as it is a unique technology with completely avatar". As discussed earlier, novelty is about a new and unique experience. One of the informants – Michel, a professional driver – was interested to know about the working of VR and its experience "I never experienced it before, so I want to see how it works and how it feels like… to see the new technology".

Fabian, a university student, also highlighted the new experience by saying, "a new experience to see the working of a steam engine, every part is moving, and also for a learning purpose". Alan, a businessman, commented about VR usage to get relaxation from the daily routine "after office and a hectic day, it is a new thing to relax". George,

a marketing manager, mentioned the unique and immersive experience "virtual reality technology is very different, different working style and very immersive". Overall, the informants' information is also aligned with the extant literature that VR is a novel technology (Nagy & Turner, 2019; Waycott et al., 2018). Contrary, the role of novelty with VR is yet to be studied empirically – specifically in tourism – extant literature lacks the role of novelty in forming experience (Mitas & Bastiaansen, 2018).

4.4.4 Telepresence

Telepresence is defined as a characteristic of technology that generates a computer-mediated environment in which users feel themselves in an artificial environment compared to the immediate real or physical environment (Steuer, 1992; Suh & Chang, 2006). The informants also explained the feeling of being there by mentioning that "graphics and real-time incorporation of the movement in a virtual environment are outstanding… it was not easy to say the virtual environment is not real", George, a marketing manager. Modern VR devices can provide ultra-high-definition vision and sound, which senses the head movement in a 360-degree dimension that perfectly blends the real movement with a computerised environment (Wheeler, 2016). Moreover, tracking system devices of VR have an essential role in providing an authentic feel of the virtual environment by tracking the orientation and position of a user. These devices replicate the original orientation and position of a user in a virtual environment (Caserman et al., 2019). Therefore, Lara, a school teacher, mentioned that "the experience was very real in virtual reality, I felt I'm physically inspecting Benz car, steam engine, and Otto Lilienthal's flight". Katerine, a university student, also stated the same "I totally indulged in the view".

The VR experience at Deutsches Museum begins with a scene where a user is surrounded by four different VR worlds: a steam engine, automobile, glider, and landing on the moon. By using an HTC controller, the user can select any VR world of

their choice. All four VR worlds provide an audio-visual experience in which a user can freely teleport to different locations within the VR world, easily walk towards the virtual content or sit to observe it. Diana, a grocery store in charge, mentioned that "in a moment you can see many things in a normal world". Joseph, a factory worker, stated, "to visit a new world, not the real world, to escape from the school time and daytime routine. It's very interesting". Paul, a banking officer, highlighted the incredible telepresence experience from VR by citing that "I was not expecting, and shocked to see the mode of transportation, and teleporting with it. I thought it would be weirder… very unexpected things to do just like you just take a step, teleport, everything flips the colours and the distance". The literature also supports that VR provides higher telepresence and creates a positive attitude towards a tourism site (Tussyadiah et al., 2018), a positive visiting experience (Jung et al., 2016), and a flow experience (D. Kim & Ko, 2019).

4.4.5 Reuse intention

Reuse intention is a willingness to use VR at different tourism destinations. This research operationalised the reuse intention as a construct to study the visitors' intention to use multi-sensory VR at tourism destinations. Lara mentioned, "I will use it again" and Martin stated, "I would do it again". It is also empirically proven in the literature that reuse intention plays a vital role in predicting consumer behaviour (H. B. Kim et al., 2009; So & Kim, 2013).

4.4.6 Purchase intention

Purchase intention is a willingness to buy VR for personal or public use as mentioned by Lara "I'll recommend the school to purchase it for the students", whereas Alan stated that "I want to see VR because we both want to purchase it". Martin and Paul also showed a willingness to buy VR by saying, "I also want to buy it" and "to experience it for buying it, which was really really good" respectively.

4.4.7 Other motivations

The informants also mentioned several unique motivations, such as the recommendation from their peers "my friend told me that virtual reality is very entertaining, so I thought to use it" (Alan). Other informants mentioned experiencing the technology "to know how much it is different from other technologies" (George), "trying to find out, how I will react to be in virtual environment. It is interesting to me which of my sense I can use and I cannot" (Paul) and "I love playing games, when I first heard about virtual reality, I thought it's amazing, I should try it. I cannot try this VR at home due to less space" (Fabian).

Figure 4.6: Emerging themes from interviews

Table 4.2: Profiles of the interviewees

No	Pseudonym	Gender	Age category	Education	Profession
1	Alan	Male	Thirties	Masters	Business (Retail)
2	Joseph	Male	Forties	Apprenticeship	Factory worker
3	George	Male	Thirties	Masters	Marketing Manager
4	Martin	Male	Twenties	Polytechnic certificate	Factory worker
5	Paul	Male	Thirties	Masters	Banking
6	Lara	Female	Thirties	Undergraduate	Education
7	Fabian	Male	Twenties	Undergraduate	Student
8	Diana	Female	Thirties	Undergraduate	Grocery Store in charge
9	Michel	Male	Forties	Schooling	Transportation
10	Danny	Male	Forties	Masters	Business (Shop)
11	Katrine	Female	Twenties	Masters	Student

Table 4.3: Quotes by interviewees

No	Variable	Respondent	Quotes
1	**Entertainment**	Alan	Virtual reality is entertaining, and interesting how it captures our movement
		Katrine	I totally indulged in the view… it is entertaining but the time was limited
		Diana	The adventure is real, feeling is very good and it's fun to use
		Martin	VR experience was really fun and cool
		Paul	Playing golf on the moon was really fun
2	**Education**	Lara	VR is a good way to provide education and learning. I also learned about landing on the moon, steam engine, Benz car and first glider
		George	I got education related to the inventions of classical technologies
		Katrine	VR content is good to get new information and education, not only entertainment
		Joseph	To get new information to the brain, not the real but artificial and to the nearest point
		Fabian	It is a new experience to see the working of a steam engine, every part is moving, and also for a learning purpose
		Danny	To learn something about virtual reality, how it works and of course to get some information about the topics moon landing and the flight shown of Otto Lilienthal. It was quite interesting

3	**Novelty**	Lara	We are on a recreational tour, and my students were interested in using VR, as it is a unique technology with completely avatar
		Michel	I never experienced it before, so I want to see how it works and how it feels like… to see the new technology
		Fabian	A new experience to see the working of a steam engine, every part is moving, and also for a learning purpose
		Alan	After office and a hectic day, it is a new thing to relax
		George	Virtual reality technology is very different, different working style and very immersive
4	**Telepresence**	George	Graphics and real-time incorporation of the movement in a virtual environment are outstanding… it was not easy to say the virtual environment is not real
		Lara	The experience was very real in virtual reality, I felt I'm physically inspecting Benz car, steam engine and Otto Lilienthal's flight
		Katrine	I totally indulged in the view
		Diana	In a moment you can see many things in a normal world
		Joseph	To visit a new world, not the real world, to escape from the school time and daytime routine. It's very interesting
		Paul	I was not expecting, and shocked to see the mode of transportation, and teleporting with it. I thought it would be weirder… very unexpected things to do just like you just take a step, teleport, everything flips the colours and the distance
5	**Reuse intention**	Lara	I will use it again
		Martin	I would do it again
6	**Purchase intention**	Lara	I will recommend the school to purchase it for the students
		Alan	I want to see VR because we both want to purchase it
		Martin	I also want to buy it
		Paul	To experience it for buying it, which was really really good

4.5 Quantitative data collection

Most of the literature published in the context of VR has used students as the main respondents, but future researchers must invite actual users as the primary respondents (Loureiro et al., 2019). *"Particularly older consumers….this target can be important not only for consumer studies, but also for citizens when some social equipment is projected, or for tourists who intend to visit a destination"* (Loureiro et al., 2019, p. 13). Therefore, this research collected data from actual users who were

visiting the VRlab of the Deutsches Museum with diverse age groups. The research dealing with first-hand quantitative data collection has several benefits (B. R. Johnson & Christensen, 2019):

- Research findings can be easily generalised
- Minimal impact of the researcher on research findings
- Collection of the data and its analysis is quick and cheap
- Helpful in collecting data from a large population
- Control of several constructs to study causality
- Testing of existing theories
- Testing of the hypotheses that were developed before collecting the data

Survey research design and experiment are two main types of positivism philosophical paradigm or first-hand quantitative data collection. Survey research design is defined by Check and Schutt (2012, p. 160) as *"the collection of information from a sample of individuals through their responses to questions".* This research design has a tendency to allow the researchers to use different ways to recruit participants and to also adopt different methods of instrumentation (Ponto, 2015). On the other hand, experiment deals with the manipulation of independent variables to study the influence on dependent variable (Sternthal et al., 1987). This research design has a tendency to explain the phenomenon of cause and effect. Primarily, it deals with the stimuli and comparison of different groups to get the results (Blom-Hansen et al., 2015).

The choice of a research design is based on several factors, for instance, objective of the research, the type of research questions to be answered, and resource availability (Ponto, 2015). As the main objective of this research is to study the gratifications sought and gratifications obtained in the context of virtual reality and tourism. Therefore, survey research design is a suitable design for this research. As it is

also evident from the literature that surveys are mostly used in psychological and social science research to explore human behaviour (Singleton & Straits, 2017). As also mentioned by Ghazali (2011) *"the relatively mature level of research in this area within the consumer behaviour field justifies the utilisation of the survey approach"* (p. 152).

There are two types of surveys used in the literature: cross-sectional and longitudinal. The cross-sectional survey is administered for one period of time, whereas a longitudinal survey is administered for an extended time (Creswell, 2014). This research aims not to collect data over an extended period of time; hence, a cross-sectional survey design is used to collect data from visitors visiting the Deutsches Museum. This methodology is also used in the latest research where researchers showed an underwater VR to visitors at a marine life centre in France (S. Hudson et al., 2019).

Two big brochures (English and German) were displayed at the entrance of the VRlab to brief the visitors about the purpose of research, objectives, and data collection process. Visitors who expressed their interest in participating in the study were given a pre usage questionnaire. They were kindly asked to complete the questionnaire while seated at tables and chairs provided within the VRlab premises. Once they finished filling out the questionnaire, they had a 15-minute VR experience, followed by five minutes to readjust and return to their normal state. Subsequently, they were requested to answer a post usage questionnaire.

4.5.1 Sampling

It is a process of making inferences about the whole population to get a small sample for collection of the data and to generalise the results to the entire population. It is about taking a subset from the entire population or sampling frame (Henry, 1990).

Sampling is divided into two general types that are (a) Probability or random sampling and (b) Non-probability or non-random sampling (Henry, 1990).

Probability sampling provides an opportunity for every member of the population to participate in research or be part of a sample. This sampling generates a sample that is a good representation of the population, and it is free from any biasness (Alvi, 2016). It has four types that are simple random sampling, systematic random sampling, stratified random sampling, and cluster random sampling.

In non-probability sampling, every subject from the population does not have a chance to be selected for research. It is beneficial in those cases where the population is unknown, the list of a complete sampling frame cannot be generated, or the researcher does not have access to the population (Henry, 1990). It also has four main types quota sampling, snowball sampling, convenience sampling, and purposive or judgmental sampling.

According to the nature of this research, convenience sampling was adopted because the respondents were easily and readily available at Deutsches Museum, and respondents were selected based on their availability and willingness to take part in this research (Shantikumar, 2018). Convenience sampling is helpful to get a good sample from the targeted population without wasting extra money, time, and resources (Zikmund, 2002). Therefore, the sampling frame included those visitors who were willing to participate in a study, and the questionnaire was only given to those who were more than 18 years of age. This sampling also has the drawback of not having random sampling, but its positive aspects are significantly stronger compared to the drawback and is suitable for this research.

4.5.2 Determination of sample size

According to Hair et al. (2011), a minimum sample should be five times more than the total number of items. The total items in the instrument for analysis one are 38 and for analysis two are 25. So, according to Hair et al. (2011), the minimum threshold is 190 for analysis 1 and 100 for analysis 2. Another criterion to calculate the minimum sample is the use of GPower (Dattalo, 2009), which computed a total of 74 sample size for this research. Most importantly, a minimum of 200 sample is required to conduct structural equation modelling (Kline, 2011).

The data collection from one respondent took approximately 30 minutes. For instance, an average of five minutes to answer the pre usage questionnaire; afterwards, 15 minutes of experiencing VR; five minutes to get normalised after experiencing VR; and five minutes to answer the post usage questionnaire. The efficiency of the data collection process was also reduced due to the criterion of getting responses from visitors who have experienced all four VR contents within 15 minutes. Initially, 356 visitors filled out the pre-usage questionnaire. Out of these 356 respondents, 91 respondents did not experience all four VR contents for 15 minutes. Hence, these 91 responses were deleted. Further, 38 responses were also deleted who were less than 18 years of age. Finally, a total of 227 samples were collected for the analysis to meet the criteria mentioned above.

These 227 responses are also considered a sufficient sample according to the top-tier journals' academic literature on VR and tourism (see Table 2.9). For example, Flavián et al. (2019) published a paper in the Journal of Travel & Tourism Marketing with 202 responses. Schiopu et al. (2021) published in Telematics & Informatics journal with a sample of 89. Other scholars published in Tourism Management with 198 sample (Y. C. Huang et al., 2013), 103 sample (Skard et al., 2021), and 181 sample (Itani & Hollebeek, 2021). S. Hudson et al. (2019) published in Journal of Business

Research with a sample of 234. X. Y. Leung et al. (2020) published in International Journal of Hospitality Management with a sample of 169 and An et al. (2021) published in Journal of Destination Marketing & Management having a sample of 220.

4.6 Operationalisation of research constructs

The instrument has been designed according to the following guidelines discussed in the handbook of Marketing Scales by Bearden et al. (2010):

1) The measure must deal with the theoretical and/or conceptual guidelines

2) Minimum of three items to measure a single construct

3) Items must be from the same research area

4) Items must have a measuring scale, e.g., 7 points Likert scale, or semantic scale

5) Reliability & validity tested

Constructs in the instrument are of two types, formative and reflective (Jarvis et al., 2003). Multiple items influence or define the formative construct; these items may not correlate, positively or negatively, with each other (Freeze & Raschke, 2007). Therefore, researchers discourage calculating the reliability and discriminant validity of the formative constructs (Wong, 2013). This discouragement is that it is not useful to calculate outer loadings, reliability, and AVE of the formative construct with uncorrelated measures because each item is independent of another item and represents a specific underlying dimension (Chin, 2010; Chin et al., 1997).

Reflective constructs usually have interchangeable items that are highly correlated, and deletion of an item does not alter the conceptual domain of the construct. Hence, the researchers have suggested calculating the reliability and validity of the reflective constructs, for instance, outer loadings, reliability, and AVE (Hair, Ringle, et al., 2011; Jarvis et al., 2003; Petter et al., 2007).

Jarvis et al. (2003) thoroughly distinguished between formative and reflective constructs (see Table 4.4). The first rule of the difference in the direction of an arrow. An arrow from items to construct represents formative construct, whereas an arrow from construct to items represents reflective construct. As discussed earlier, items in the formative construct define the construct. On the other hand, items in the reflective construct are manifestations of the construct. The items influence a formative construct; conversely, reflective items are influenced by the construct.

The second rule of the difference is interchangeability of the items. Formative items cannot be interchangeable, but reflective items can be interchangeable. Furthermore, formative items do not share the same content or common theme, whereas reflective items share the same content or common theme. Dropping an item of a formative construct can change the conceptual domain of the construct; contrary, reflective constructs can drop an item without changing the conceptual domain of the construct.

Third rule is covariation among the items. Formative items are not necessary to covary with each other; conversely, reflective items are necessary to covary. The last rule is the nomological net of the construct indicators. Formative items can have different nomological, but reflective items should not have different nomological. In the same way, formative items can have different antecedents and consequences, but reflective items must have the same antecedents and consequences.

Table 4.4: Decision rules for determining whether a construct is formative or reflective

Rules	Formative model	Reflective model
1. Direction of causality from construct to measure implied by the conceptual definition	• Direction of causality is from items to construct	• Direction of causality is from construct to items
• Are the indicators (items) (a) defining characteristics or (b) Manifestations of the construct?	• Indicators are defining characteristics of the construct	• Indicators are manifestations of the construct • Changes in the indicator

• Would changes in the indicators/items cause changes in the construct or not? • Would changes in the construct cause changes in the indicators?	• Changes in the indicators should cause changes in the construct • Changes in the construct do not cause changes in the indicators	should not cause changes in the construct • Changes in the construct do cause changes in the indicators
2. Interchangeability of the indicators/items • Should the indicators have the same or similar content? • Do the indicators share a common theme? • Would dropping one of the indicators alter the conceptual domain of the construct?	• Indicators need not be interchangeable • Indicators need not have the same or similar content • Indicators need not share a common theme • Dropping an indicator may alter the conceptual domain of the construct	• Indicators should be interchangeable • Indicators should have the same or similar content • Indicators should share a common theme • Dropping an indicator should not alter the conceptual domain of the construct
3. Covariation among the indicators • Should a change in one of the indicators be associated with changes in the other indicators?	• Not necessary for indicators to covary with each other • Not necessarily	• Indicators are expected to covary with each other • Yes
4. Nomological net of the construct indicators • Are the indicators/items expected to have the same antecedents and consequences?	• Nomological net for the indicators may differ • Indicators are not required to have the same antecedents and consequences	• Nomological net for the indicators should not differ • Indicators are required to have the same antecedents and consequences

Source: Jarvis et al. (2003)

On the basis of the above discussion and literature review, the researcher followed a systematic process for describing the construct as formative or reflective. Table 4.5 depicts the construct development process in which construct is defined, items to measure constructs are given, and the source of the items. Items for this research were adapted from previous research (see Table 4.5). For example, education from Jung et al. (2016), entertainment (Bae, 2018), novelty (Sundar & Limperos, 2013), telepresence (B. Park et al., 2010), pleasantness of experience (Van Kerrebroeck et al., 2017a), reuse intention (J. C. C. Lin & Lu, 2000), purchase intention (B. Lu et al., 2016), and personal importance (Bhushan et al., 2019). These items were shared with the expert panel during the focus group to get their feedback on all items.

Table 4.5: Construct development process

Construct	Definition	No. of items	Items	Items in form of GS and GO	Source
Entertainment	Activities that fulfil intrinsic motivations by providing an amusing and enjoying experience	3	Fun	…I will have fun*	Bae (2018)
				…I got fun**	
			Enjoy	…I will enjoy*	
				…I got enjoyment**	
			Entertained	…I will be entertained*	
				…I got entertainment**	
Education	Visitors' preference to increase their knowledge and/or skills through educational events that actively engage the mind and/or the body	4	Learn something new	…I will learn something new*	Jung et al. (2016)
				…I learned something new**	
			Become more knowledgeable	…I will become more knowledgeable*	
				…I became more knowledgeable**	
			Curiosity to learn new things	…it will stimulate my curiosity to learn new things*	
				VR stimulated my curiosity to learn new things	
			Good experience for learning	…it will provide a good experience for learning*	
				VR provided a good experience for learning	
Novelty	Phenomenon that attracts attention of a tourist by giving a chance to feel a different or unique scenario through new technology	4	Unusual experience	…its experience will be unusual*	Sundar & Limperos (2013)
				VR experience was unusual	
			Different interface	…its interface will be different*	
				VR interface was different	
			Something new	…it will be something new*	
				VR experience was something new	
			Innovative	…this technology will be innovative*	
				VR technology was innovative	
Telepresence	The extent to which the user feels present in the mediated environment rather than in the immediate physical environment	4	Forget where I am	…I will forget where I am*	B. Park et al. (2010)
				…I forgot where I am**	
			Visit a new world created by VR	…I will visit a new world created by VR*	
				…I visited a new world created by it**	
			Escape from the reality	…I will escape from the reality*	

				…I escaped from the reality**	
			VR world is real for me	...the world generated by VR will be more real for me*	
				…the world generated by VR was more real for me**	
Personal importance	The degree of affect – positive or negative – toward an attribute or behavioural outcome	4	Entertainment	To get entertainment (i.e., fun, enjoyment and entertainment)***	Bhushan et al. (2019)
			Education	To get education (i.e., learn something new, to become more knowledgeable, stimulate the curiosity to learn new things and VR will provide a good experience for learning)***	
			Novelty	To experience the novelty (i.e., unusual experience, different interface, something new & innovative technology)***	
			Telepresence	To experience the Telepresence (i.e., forget where I am, visit a new VR world, escape from the reality and VR world will be more real for me)***	
Pleasantness of experience	A collection of positive and negative emotions	4	VR experience made me unhappy/happy ŧ		Van Kerrebroeck et al. (2017a)
			VR experience made me unsatisfied/satisfied ŧ		
			VR experience made me bored/relaxed ŧ		
			VR experience made me annoyed/pleased ŧ		
Reuse intention	The visitors' intention for using multi-sensory VR at tourism destinations	3	I intend to use this VR in the future		J.C.C. Lin & Lu (2000)
			This VR is worthy of use		
			I will recommend this VR to other people		
Purchase intention	The willingness of a visitor to purchase VR for the personal usage	3	I am very likely to buy this VR technology		B. Lu et al. (2016)
			I would consider buying this VR technology in the future		
			I intend to buy this VR technology		

*When using this VR, I expect that…

**By using Virtual Reality…

***How important is it to you that these experiences are at least met by using virtual reality?

ŧ Semantic differential scale

The following sub section presents the decision rules for determining whether a construct is formative or reflective and a discussion of every construct to categorise as formative or reflective.

4.6.1 Entertainment

Entertainment is defined as activities that fulfil intrinsic motivations by providing an amusing and enjoyable experience (Venkatesh, 2000). Items to measure entertainment are adapted from Bae (2018). Bae used entertainment to study the entertaining impact of Facebook on users' satisfaction and continuance intention (Bae, 2018). In academic literature, entertainment is mainly used as a reflective construct, and the same is in the study of Bae (2018). Table 4.5 shows items for entertainment, and the following table 4.6 is used to categorise entertainment as formative or reflective. Items to measure entertainment are analysed according to the four criteria mentioned by Jarvis et al. (2003). According to rule one, entertainment is a reflective construct. Because entertainment items are considered manifestations of the construct; hence, changes in items will not change or affect the construct. For rule 2, all entertainment items are easily interchangeable because they measure the same content. For instance, fun, enjoyment, and entertainment. Furthermore, dropping any one item will not impact the overall construct of entertainment. Therefore, entertainment is a reflective construct according to rule 2.

Rule 3 discusses the covariation among the indicators. Entertainment items covary with each other because increase in fun will lead to enjoyment. Consequently, entertainment is a reflective construct according to rule 3. According to rule 4, entertainment is a reflective construct. Because all of the items reflect the same content; thus, all items will have the same antecedents and consequences. After analysing all entertainment items according to the four criteria mentioned by Jarvis et al. (2003), this research concludes that entertainment is a first-order reflective construct.

Table 4.6: Construct analysis of entertainment to be categorised as a formative or reflective

Criteria	Construct Analysis	Decision	
		Formative	Reflective
Rule 1. Direction of causality from construct to measure implied by the conceptual definition	Entertainment items are considered manifestations of the construct; hence, changes in items will not change or affect the construct		Rule 1 declares entertainment items as reflective
2. Interchangeability of the indicators/items	All items of entertainment are easily interchangeable because they measure the same content. For instance, fun, enjoyment, and entertainment. Furthermore, dropping any one item will not have any impact on the overall construct of entertainment		Rule 2 declares entertainment items as reflective
3. Covariation among the indicators	Entertainment items covary with each other because an increase in fun will lead to enjoyment		Rule 3 declares entertainment items as reflective
4. Nomological net of the construct indicators	All of the items reflect the same content; thus, all items will have the same antecedents and consequences		Rule 4 declares entertainment items as reflective
Final decision	**Entertainment is a first-order reflective construct**		√

4.6.2 Education

Education is defined as visitors' preference to increase their knowledge and/or skills through educational events that actively engage the mind and/or the body (Pine & Gilmore, 1999). Items to measure education are adapted from Jung et al. (2016). They used education to study the impact of VR and AR on museum visitors' experience (Jung et al., 2016). In academic literature, education is mainly used as a reflective construct. Table 4.5 shows items for education, and the following table 4.7 is used to categorise education as formative or reflective. Items to measure education are analysed according to the four criteria mentioned by Jarvis et al. (2003). According to rule one, education is a reflective construct. Because education items are considered manifestations of the construct; hence, changes in items will not change or affect the construct. For rule 2, all education items are easily interchangeable because they measure the same content. For instance, learning something new, becoming more knowledgeable, curiosity to learn new things, and having a good experience for

learning. Furthermore, dropping any one item will not impact the overall construct of education. Therefore, education is a reflective construct according to rule 2.

Rule 3 discusses the covariation among the indicators. Education items covary with each other because learning something new will lead to a knowledgeable person. Consequently, education is a reflective construct according to rule 3. According to rule 4, education is a reflective construct. Because all of the items reflect the same content, thus, all items will have the same antecedents and consequences. After analysing all education items according to the four criteria mentioned by Jarvis et al. (2003), this research concludes that education is a first-order reflective construct.

Table 4.7: Construct analysis of education to be categorised as a formative or reflective

Criteria	Construct Analysis	Decision	
		Formative	Reflective
Rule 1. Direction of causality from construct to measure implied by the conceptual definition	Education items are considered manifestations of the construct; hence, changes in items will not change or affect the construct		Rule 1 declares education items as reflective
2. Interchangeability of the indicators/items	All education items are easily interchangeable because they measure the same content. For instance, learning something new, becoming more knowledgeable, curiosity to learn new things and having a good experience for learning. Furthermore, dropping any one item will not have any impact on the overall construct of entertainment		Rule 2 declares education items as reflective
3. Covariation among the indicators	Education items covary with each other because learning something new will lead to a knowledgeable person		Rule 3 declares education items as reflective
4. Nomological net of the construct indicators	All of the items reflect the same content; thus, all items will have the same antecedents and consequences		Rule 4 declares education items as reflective
Final decision	**Education is a first-order reflective construct**		√

4.6.3 Novelty

Novelty is defined as a phenomenon that attracts a tourist's attention by giving a chance to feel a different or unique scenario (T. H. Lee & Crompton, 1992). Items to

measure novelty are adapted from Sundar & Limperos (2013). They proposed novelty to study the impact of new technologies on users' behaviour. Table 4.5 shows items for novelty, and the following table 4.8 is used to categorise novelty as formative or reflective. Items to measure novelty are analysed according to the four criteria mentioned by Jarvis et al. (2003). According to rule one, novelty is a reflective construct. Because novelty items are considered manifestations of the construct, hence, changes in items will not change or affect the construct. For rule 2, all novelty items are easily interchangeable because they measure the same content. For instance, the VR experience is unusual, different interface, something new, and innovative. Furthermore, dropping any one item will not have any impact on overall construct of novelty. Therefore, novelty is a reflective construct according to rule 2.

Rule 3 discusses the covariation among the indicators. Novelty items covary with each other because the unusual experience will lead to experiencing something new. Thus, novelty is a reflective construct according to rule 3. According to rule 4, novelty is a reflective construct. Because all items reflect the same content; thus, all items will have the same antecedents and consequences. After analysing all novelty items according to the four criteria mentioned by Jarvis et al. (2003), this research concludes that novelty is a first-order reflective construct.

Table 4.8: Construct analysis of novelty to be categorised as a formative or reflective

Criteria	Construct Analysis	Decision	
		Formative	Reflective
Rule 1. Direction of causality from construct to measure implied by the conceptual definition	Novelty items are considered manifestations of the construct; hence, changes in items will not change or affect the construct		Rule 1 declares novelty items as reflective
2. Interchangeability of the indicators/items	All novelty items are easily interchangeable because they measure the same content. For instance, the VR experience is unusual, has a different interface, and is something new and innovative. Furthermore, dropping any one item will not have any impact on the overall construct of novelty		Rule 2 declares novelty items as reflective

3. Covariation among the indicators	Novelty items covary with each other because the unusual experience will lead to experiencing something new		Rule 3 declares novelty items as reflective
4. Nomological net of the construct indicators	All of the items reflect the same content; thus, all items will have the same antecedents and consequences		Rule 4 declares novelty items as reflective
Final decision	**Novelty is a first-order reflective construct**		√

4.6.4 Telepresence

Telepresence is defined as the extent to which an individual feels present in the mediated environment rather than in the immediate physical environment (Steuer, 1992; Suh & Chang, 2006). Items to measure telepresence are adapted from B. Park et al. (2010). They used telepresence to study blogging motivational behaviour. Table 4.5 shows items for telepresence, and the following table 4.9 is used to categorise telepresence as formative or reflective. Items to measure telepresence are analysed according to the four criteria mentioned by Jarvis et al. (2003). According to rule one, telepresence is a reflective construct. Because telepresence items are considered manifestations of the construct, hence, changes in items will not change or affect the construct. For rule 2, all items of telepresence are easily interchangeable because they measure the same content. For instance, by using VR I will: forget where I am, visit a new world created by VR, escape from reality, and VR world is more real. Furthermore, dropping any one item will not have any impact on the overall construct of telepresence. Therefore, telepresence is a reflective construct according to rule 2.

Rule 3 discusses the covariation among the indicators. Telepresence items covary with each other because visiting a computerised environment will lead to escape from reality. Thus, telepresence is a reflective construct according to rule 3. Again, according to rule 4, telepresence is a reflective construct. Because all items reflect the same content; thus, all items will have the same antecedents and consequences. After

analysing all items of telepresence according to the four criteria mentioned by Jarvis et al. (2003), this research concludes that telepresence is a first-order reflective construct.

Table 4.9: Construct analysis of telepresence to be categorised as a formative or reflective

Criteria	Construct Analysis	Decision	
		Formative	Reflective
Rule 1. Direction of causality from construct to measure implied by the conceptual definition	Telepresence items are considered manifestations of the construct; hence, changes in items will not change or affect the construct		Rule 1 declares telepresence items as reflective
2. Interchangeability of the indicators/items	All items of telepresence are easily interchangeable because they measure the same content. For instance, by using VR, I will: forget where I am, visit a new world created by VR, escape from reality and the VR world is more real. Furthermore, dropping any one item will not have any impact on the overall construct of telepresence		Rule 2 declares telepresence items as reflective
3. Covariation among the indicators	Telepresence items covary with each other because visiting a computerised environment will lead to escape from the reality		Rule 3 declares telepresence items as reflective
4. Nomological net of the construct indicators	All of the items reflect the same content; thus, all items will have the same antecedents and consequences		Rule 4 declares telepresence items as reflective
Final decision	**Telepresence is a first-order reflective construct**		√

4.6.5 Pleasantness of experience

Pleasantness of experience is defined as a collection of positive and negative emotions (Van Kerrebroeck et al., 2017a). Items to measure pleasantness of experience are adapted from Van Kerrebroeck et al. (2017a). They used pleasantness of experience to study pleasant shopping behaviour. Table 4.5 shows items for the pleasantness of experience, and the following table 4.10 is used to categorise pleasantness of experience as formative or reflective. After analysing all items of pleasantness of experience according to the four criteria mentioned by Jarvis et al. (2003), this research concludes that pleasantness of experience is a first-order reflective construct.

Table 4.10: Construct analysis of pleasantness of experience to be categorised as a formative or reflective

Criteria	Construct Analysis	Decision	
		Formative	Reflective
Rule 1. Direction of causality from construct to measure implied by the conceptual definition	Pleasantness of experience items are considered manifestations of the construct; hence, changes in items will not change or affect the construct		Rule 1 declares pleasantness of experience items as reflective
2. Interchangeability of the indicators/items	All items of the pleasantness of experience are easily interchangeable because they measure the same content. For instance, the VR experience made me: unhappy/happy; unsatisfied/satisfied; bored/relaxed; and annoyed/pleased. Furthermore, dropping any one item will not have any impact on the overall construct of pleasantness of experience		Rule 2 declares pleasantness of experience items as reflective
3. Covariation among the indicators	Pleasantness of experience items covary with each other because the pleasing experience will lead to satisfaction		Rule 3 declares pleasantness of experience items as reflective
4. Nomological net of the construct indicators	All of the items reflect the same content; thus, all items will have the same antecedents and consequences		Rule 4 declares pleasantness of experience items as reflective
Final decision	**Pleasantness of experience is a first-order reflective construct**		√

4.6.6 Reuse intention

Reuse intention is defined as the visitors' intention to use multi-sensory VR at tourism destinations. Items to measure reuse intention are adapted from J.C.C. Lin & Lu (2000). They used it to study the reuse intention of a website. Table 4.5 shows items for reuse intention, and the following table 4.11 is used to categorise reuse intention as formative or reflective. After analysing all items of reuse intention according to the four criteria mentioned by Jarvis et al. (2003), this research concludes that reuse intention is a first-order reflective construct.

Table 4.11: Construct analysis of reuse intention to be categorised as a formative or reflective

Criteria	Construct Analysis	Decision	
		Formative	Reflective
Rule 1. Direction of causality from construct to measure implied by the conceptual definition	Reuse intention items are considered manifestations of the construct; hence, changes in items will not change or affect the construct		Rule 1 declares reuse intention items as reflective
2. Interchangeability of the indicators/items	All items of reuse intention are easily interchangeable because they measure the same content. For instance, I intend to use this VR in the future, this VR is worthy of use, and I will recommend this VR to other people. Furthermore, dropping any one item will not have any impact on the overall construct of reuse intention		Rule 2 declares reuse intention items as reflective
3. Covariation among the indicators	Reuse intention items covary with each other because if a person thinks VR is worthy of use so they will be intended to use VR in the future		Rule 3 declares reuse intention items as reflective
4. Nomological net of the construct indicators	All of the items reflect the same content; thus, all items will have the same antecedents and consequences		Rule 4 declares reuse intention items as reflective
Final decision	**Reuse intention is a first-order reflective construct**		√

4.6.7 Purchase intention

Purchase intention is defined as the willingness of a visitor to purchase VR for personal usage. Items to measure purchase intention are adapted from B. Lu et al. (2016). They used it to study the intention to purchase through social commerce. Table 4.5 shows items for purchase intention, and the following table 4.12 is used to categorise purchase intention as formative or reflective. After analysing all items of purchase intention according to the four criteria mentioned by Jarvis et al. (2003), this research concludes that purchase intention is a first-order reflective construct.

Table 4.12: Construct analysis of purchase intention to be categorised as a formative or reflective

Criteria	Construct Analysis	Decision	
		Formative	Reflective
Rule 1. Direction of causality from construct to measure implied by the conceptual definition	Purchase intention items are considered manifestations of the construct; hence, changes in items will not change or affect the construct		Rule 1 declares purchase intention items as reflective
2. Interchangeability of the indicators/items	All items of purchase intention are easily interchangeable because they measure the same content. For instance, I am very likely to buy this VR technology, I would consider purchasing this VR technology in the future, and I intend to buy this VR technology. Furthermore, dropping any one item will not have any impact on the overall construct of purchase intention		Rule 2 declares purchase intention items as reflective
3. Covariation among the indicators	Purchase intention items covary with each other because all items are related to purchase		Rule 3 declares purchase intention items as reflective
4. Nomological net of the construct indicators	All of the items reflect the same content; thus, all items will have the same antecedents and consequences		Rule 4 declares purchase intention items as reflective
Final decision	**Purchase intention is a first-order reflective construct**		√

All of the constructs used in the current study had multiple reflective items (Diamantopoulos et al., 2012). The seven-point Likert scale was used to measure entertainment, education, novelty, telepresence, reuse, and purchase intention. A semantic differential scale from -3 to +3 was used to measure pleasantness of experience and familiarity. Familiarity with Otto Lilienthal, Benz car, Sulzer steam engine, and Apollo 17 mission was asked before and after VR use.

According to the previous studies, the wording of items was changed to measure GS and GO (Bae, 2018; Palmgreen & Rayburn, 1985; Rokito et al., 2019). For example, items to measure GS were "…I will learn something new" and "…I will have fun". For GO, these items were used as "…I learned something new" and "…I got fun". Other than these constructs, this research also used control variables like age, gender, education, and VR familiarity.

To get the discrepancies score of GO-GS, the mean scores of GS items were subtracted from the mean scores of GO items. For example, GS entertainment was measured using three items. The mean scores of all three items were subtracted from the mean score of GO to get a value of GO-GS entertainment (Bae, 2018). The same was done with other constructs such as education, novelty, and telepresence.

4.6.8 Pilot study

The pre-testing of a questionnaire before collecting the data is very important to ensure the excellent quality of a research instrument (Dillman, 1991). The pre-testing helps amend the items that are easy to understand for the targeted sample and interpretation according to the researcher's original intention. It is also helpful in addressing unsuitable abbreviations, misleading questions, and double-barrelled or vague questions (Dillman, 1991, 2007).

The pilot study for this research was conducted in two phases: subject experts and actual respondents. The face validity, content validity, and internal consistency were tested according to the guidelines provided by Hardesty and Bearden (2004) and Zamanzadeh et al. (2015). The face validity and content validity were assessed through the focus group consisting of four subject experts (two digital marketing Professors, a PhD scholar, and a practitioner). As the items were adapted from previous research, the experts suggested only minor revisions in the items for the back-translation process, changing one of the items of entertainment construct and changing the wording for the items of personal importance. For internal consistency, a sample of 20 respondents from the Deutsches Museum was taken according to Hill (1998) and Isaac and Michael (1995). Out of these 20 respondents, 10 were given an English questionnaire, and another 10 were given a German questionnaire (see detail in section 4.6.9). Table 4.13 presents the Cronbach's alpha value of all the constructs which were more than the

threshold of 0.7 (Hair, Sarstedt, Ringle, et al., 2012). Hence, showing good face validity, content validity, and internal consistency.

Table 4.13: Pilot study

Constructs	Cronbach's Alpha
GS-Entertainment	0.921
GS-Education	0.913
GS-Novelty	0.907
GS-Telepresence	0.862
GO-Entertainment	0.946
GO-Education	0.874
GO-Novelty	0.892
GO-Telepresence	0.858
Pleasantness of Experience	0.890
Reuse Intention	0.923
Purchase Intention	0.947

Note: GS, gratifications sought; GO, gratifications obtained

4.6.9 Back-translation method

International visitors are more at Deutsches Museum; therefore, both English and German questionnaires were used. S. Hudson et al. (2019), in their recent research dealing with VR in the context of tourism, also adopted the back-translation method (Brislin, 1970) to convert questionnaires into the French language. This research also adopted Brislin's (1970) back-translation method by getting help from three experts to finalise the English and German language questionnaires. The English questionnaire was designed based on the suggestions provided by Werner and Campbell (1970), such as the usage of nouns, short sentences, and active tenses. Two individuals (experts in German and English languages) were given the English questionnaire to translate the questionnaire into German. These two questionnaires were separately given to another third expert to translate them back into the English language. The translated versions of English questionnaires had minor dissimilarities in some questions. Those dissimilarities were compared with both German questionnaires. According to the expert, a single questionnaire was designed by taking only the best questions. Furthermore, a decentring approach (to make changes in English questionnaire

according to the German questionnaire) was proposed to a third expert to get identical versions of English and German questionnaires, which was rejected by an expert.

4.6.10 Questionnaire development

The questionnaire can be administered by the researcher (self-administered), administered by another professional, or it can also be administered in a group. This research used a self-administered method to collect the data. The questionnaire usually has several valid and reliable items, discusses the research aims, and has demographic questions (Ponto, 2015). The questionnaire was divided into two sub-questionnaires. The first questionnaire was given to the respondents before using VR, and the second questionnaire after using VR. The first questionnaire comprised of the gratifications to use VR (gratifications sought), user's personal importance, pre-familiarity with Otto Lilienthal, Benz car, Sulzer steam engine, and Apollo 17 mission. After responding to the first questionnaire, the respondents experienced VR for 15 minutes. While experiencing VR, they could walk, sit, listen, and watch the VR content of four different events (Otto Lilienthal, Benz car, Sulzer steam engine, and Apollo 17 mission). The second questionnaire was only given to those visitors who had used VR for complete 15 minutes and watched all four events. The second questionnaire had questions related to gratifications obtained, post-familiarity, pleasantness of experience, reuse intention, purchase intention, and demographics. On average, this process took almost 30 minutes per person. In the end, candies were given to the respondents as a token of thanks.

Initially, 356 visitors filled out the pre-usage questionnaire. Out of these 356 respondents, 91 respondents did not experience all four VR contents for 15 minutes. Hence, these 91 responses were deleted. Further, 38 responses were also deleted who were less than 18 years of age. Finally, the data collection yielded 227 usable responses

after preliminary tests like identifying missing values, duplicate cases, and monotone responses (Hair et al., 2013).

4.6.10.1 Common method variance

The common method variance occurs when the respondents have to answer all questions at once. In this research, the data were collected two times; therefore, common method variance was not a potential issue. Despite of this reason, procedural precautions were taken in this research to avoid any unforeseen errors. The guidelines provided by Podsakoff et al. (2003) were used, for example, (1) an introductory statement with the anonymity of the data and general introduction about the study, (2) to reduce anxiety, it was mentioned that "there is no right or wrong answer", (3) the questionnaire had different sections like (i) introduction, (ii) items related to research model, (iii) questions regarding familiarity and (iv) demographics.

4.7 Data analysis method

This sub-section highlights the data analysis method after collecting the data. It is designed according to the latest guidelines provided by Hair et al. (2019). Initially, the data coding was performed in the SPSS, afterwards, data screening was conducted to identify (a) missing data, (b) duplicate cases, (c) outliers, (d) monotone response, and (e) data normality. (a) Missing values in the data usually cause a problem for empirical studies during the data analysis. It occurs when a respondent unintentionally or intentionally does not answer single or multiple questions. Hair et al. (2014) suggested treating more than 15% of missing values in a single response. Two main remedies are used in the literature to treat the missing values: expectation maximum likelihood (Lauritzen, 1995) and case wise deletion (Hair et al., 2014). (b) Sometimes, there are duplicate cases due to similar responses from the respondents. It is essential to address them to get good generalisability. (c) Outliers are *"an extreme response to a particular*

question or extreme response to all questions" (Hair et al., 2013). Usually, the extreme values in the data tend to distort the overall results by creating a critical effect on the correlation coefficient (Pallant, 2010). Here, extreme values referred to responses with a unique answer; for example, most respondents answered between 5 to 7, and a few answered one. As this extreme value can influence the results, scholars suggested treating them (Azizah & Mulyono, 2020). Some researchers recommended retaining the outliers depending on the impact on the results. Because treatment can provide good results but creates an issue of generalisability (Hair et al., 2013). If there are many outliers, then they must be treated, but a few cases of outliers do not create a problem during data analysis. (d) Monotone response occurs when a respondent selects one option for all the questions; for instance, the respondent selects option number four for all questions on a seven-point Likert scale questionnaire. The eradication of this issue is also necessary because it reflects biasness (Hair et al., 2014). (e) Testing for normality is considered one of the essential criteria for multivariate data analysis. The normality curve can be ball-shaped or symmetrical. The lower score frequency makes the right and left extremes of a curve, while the highest score frequency makes the middle part. The variable levels of skewness and kurtosis determine the normality (Hair et al., 2013). The distribution balance refers to the skewness, whereas the unbalanced distribution would be negatively or positively skewed. The flatness or peakedness of the distribution refers to the kurtosis. As discussed earlier, CB-SEM works well with normal data distribution, and PLS-SEM performs well with non-normal data. Therefore, section 4.7.2.5 presents the normality test.

The increased usage of structural equation modelling (SEM) is recently noticed (Matthews et al., 2016). This increase is due to the improvements in examining the reliability and validity of multi-item variables and assessing the structural model relationships (Hair, Sarstedt, Ringle, et al., 2012). SEM can simultaneously assess the

measurement (reliability, validity, VIF values) and the structural model (path relationships) through two different statistical approaches: exploratory factor analysis and structural path analysis (L. Lee et al., 2011). SEM is better for explaining the variance in the dependent variable(s) as compared to the multiple regression method because it considers both direct and indirect effects (L. Lee et al., 2011). Hence, the application of SEM for data analysis is evident from the management literature (L. J. Williams et al., 2003), marketing (L. P. Lin et al., 2020; Y. Liu et al., 2013; Mathews et al., 2016; B. Park et al., 2010; Silic & Ruf, 2018; Yuce et al., 2020), consumer psychology (Priester, 2010), information systems (Choi & Scott, 2013) and others.

The researchers can use two primary SEM methods: one is covariance-based structural equation modelling (CB-SEM; Jöreskog, 1978), and another is variance-based partial least squares structural equation modelling (PLS-SEM; Wold, 1982). Statistical packages such as MPlus, EQS, AMOS, and LISREL can perform CB-SEM. In contrast, statistical packages including SmartPLS, Visual PLS, PLS Graph, WarpPLS, and XL-Stat can perform PLS-SEM. The purpose of CB-SEM is to test or confirm the already established theory, such as an explanation. Contrary, PLS-SEM works based on a prediction-oriented approach to SEM, majorly implemented for exploratory research and also considered helpful in confirmatory research (Sarstedt et al., 2014). PLS-SEM solved the issue of seeming dichotomy between predictive and confirmatory research because the researchers prefer to get higher predictive accuracy of their model along with well-explained causal relationships (Sarstedt et al., 2018). As this approach *"implies both understanding of underlying causes and prediction, as well as description of theoretical constructs and the relationships among them"* Gregor (2006, p. 626), which is a suitable approach for prediction and explanation. Therefore, this PLS-SEM approach is appropriate and aligned with most of the business research

in which the aim is to provide recommendations for organisational practices (i.e., prediction) and test a theory (i.e., explanation) (Hair et al., 2019).

Both CB-SEM and PLS-SEM have different statistical objectives: CB-SEM tends to estimate model parameters that minimise the differences between the observed sample covariance matrix (calculated before the analysis) and the covariance matrix estimated after the revised theoretical model is confirmed (Hair, Sarstedt, Pieper, et al., 2012). Contrary to this, PLS-SEM has the statistical objective to increase the variance described in the dependent variable(s) (Hair, Sarstedt, Ringle, et al., 2012). Another basic difference in both of them is the treatment of models. For example, CB-SEM computes results based on a common factor model, whereas PLS-SEM computes results based on the composite model (Hair et al., 2017). The researchers have to calculate the covariance among all constructs used in the study to test the common factor model. Therefore, the error variance and the specific variance must be removed from the data before examining a theoretical model (Hair, Sarstedt, Pieper, et al., 2012). One drawback of the common factor model is that it removes the specific variance that could be useful to predict the dependent variable(s). Alternatively, the composite model predicts the dependent variable(s) variance by using all variances such as specific error and common variance (Hair, Sarstedt, Ringle, et al., 2012). The only drawback of the composite model is the inclusion of some error variance. It includes variance if it helps in predicting the dependent variable(s). Therefore, the composite model approach is suitable for effectively increasing the variance explained in the dependent variable(s).

The summary for selecting one of the SEM methods is given in Table. 4.14 presented by Hair, Ringle, et al. (2011). Five criteria differentiate PLS-SEM and CB-SEM: research goals, measurement model specification, structural model, data characteristics, algorithm, and model evaluation. These criteria are already discussed

above and presented in the form of a table to summarise the selection for SEM methods.

Table 4.14: Difference between PLS-SEM and CB-SEM

Criteria	PLS-SEM	CB-SEM
Research Goals	• Predicting key target constructs or identifying key 'driver' constructs • The research is exploratory or an extension of an existing structural theory	• Theory testing or theory confirmation
Measurement Model Specification	• If formative constructs are part of the structural model	• If error terms require additional specifications, such as covariation
Structural Model	• If the structural model is complex (many constructs and many indicators)	• If the model is non-recursive
Data Characteristics and Algorithm	• Sample size is small and/or non-normal data distribution	• Large data set and/or normal data
Model Evaluation	• If researcher needs to use latent variable scores in subsequent analyses	• Requires a global goodness-of-fit criterion • Need to test for measurement model invariance

Source: Hair, Ringle, et al. (2011)

The current study employed PLS-SEM (Ringle et al., 2015) to test the proposed hypothesis and the proposed theoretical model because of the below-mentioned reasons: unlike traditional CB-SEM, PLS-SEM can perform well in predicting the key target constructs, complex structural model, data with minimal sample size, residual distributions to validate a model with bootstrap resampling method as a nonparametric approach and the use of latent constructs scores (Chin et al., 2003; Hair et al., 2019; Hair, Ringle, et al., 2011; Reinartz et al., 2009).

Two-stage analytical method can be adopted after conducting the data screening. The first stage deals with the measurement model to assess the reliability and validity of the questionnaire. The structural model's second stage is evaluated to

assess the hypothesised relationships. The summary of these two-stage analytical methods is given in Table 4.15, taken from the recent work of Hair et al. (2019). A detailed analysis of measurement and structural models is provided in sections 5.4 to 5.6.

Table 4.15: Analysis of measurement and structural models

Reflective measurement models	
Reflective indicator loadings	• ≥ 0.708
Internal consistency reliability	• Cronbach's alpha is the lower bound, the composite reliability is the upper bound for internal consistency reliability. A usually lies between these bounds and may serve as a good representation of a construct's internal consistency reliability, assuming that the factor model is correct • Minimum 0.70 (or 0.60 in exploratory research) • Maximum of 0.95 to avoid indicator redundancy, which would compromise content validity • Recommended 0.80 to 0.90 • Test if the internal consistency reliability is significantly higher (lower) than the recommended minimum (maximum) thresholds. Use the percentile method to construct the bootstrap-based confidence interval; in case of a skewed bootstrap distribution, use the BCa method
Convergent validity	• AVE ≥ 0.50
Discriminant validity	• For conceptually similar constructs: HTMT < 0.90 • For conceptually different constructs: HTMT < 0.85 • Test if the HTMT is significantly lower than the threshold value
Structural model	
Collinearity (VIF)	• Probable (i.e., critical) collinearity issues when VIF ≥ 5 • Possible collinearity issues when VIF ≥ 3 – 5 • Ideally show that VIF < 3
R^2 value	• R^2 values of 0.75, 0.50, and 0.25 are considered substantial, moderate, and weak. R^2 values of 0.90 and higher are typical indicative of overfit
Q^2 value	• Values greater than 0 are consider meaningful; • Rule of thumb for Q^2 Hair et al. (2017): $0 \leq Q^2 \leq 0.15$ = weak effect $0.15 \leq Q^2 \leq 0.35$ = Medium effect $Q^2 \geq 0.35$ = Strong effect
PLSpredict	• Set k=10, assuming each subgroup meets the minimum required sample size • Use ten repetitions, assuming the sample size is large enough • $Q^2_{predict}$ values ≤ 0 indicate that the model does not outperform the most naïve benchmark (i.e., the indicator means from the analysis sample) • Compare the MAE (or the RMSE) value with the LM value of each indicator. Check if the PLS-SEM analysis (compared to the LM) yields higher prediction errors in terms of RMSE (or MAE) for all (no predictive power), the majority (low predictive power), the minority or the same number (medium predictive power), or none of the indicators (high predictive power)
Model comparisons	• Select the model that minimizes the value in BIC or GM compared to the other models in the set

Source: Hair et al. (2019)

4.7.1 Data coding

Data coding is the first step for empirical researchers to prepare the data for analysis. The researchers insert data into statistical software, including SPSS. This survey questionnaire has 38 items for analysis 1 and 25 items for analysis 2, which were uploaded on SPSS, and each item was assigned a code to differentiate from the others.

As the data were collected through a self-administered survey using the paper-pencil method. The data were manually entered in Statistical Package for the Social Sciences (SPPS) v.22. Data screening was conducted through SPSS, which is discussed in the subsequent section. After the data screening, several constructs were created according to the demand of models: 3; 4; 5; 6; and 7. Afterwards, the file was converted into comma-separated values (CSV) for doing further analysis in SmartPLS.

4.7.2 Data screening

Five essential steps were used to summarise the data screening, such as identifying missing values, duplicate cases, outliers, monotone response, and normality test.

4.7.2.1 Missing data

During a survey, there are great chances that respondents answer most of the questions but do not answer some of them willingly or unwillingly. SEM needs the complete data for analysis and usually causes a problem with missing data (R. L. Carter, 2006). Therefore, during the data collection process, the researcher tried to overcome the issue of missing values by efficiently going through the questionnaire and requesting the respondent to answer the question if it was forgotten unwillingly. In order to double-check the missing values, statistical test such as frequency was used through SPSS. The analysis showed that the data were free from missing values.

4.7.2.2 Duplicate cases

The test of "identify duplicate cases" was conducted through SPSS. The analysis concluded that there was not a single duplicate case in the data. One of the reasons could be the data collection at two times through a paper-pencil survey.

4.7.2.3 Outliers

Usually, the extreme values in the data tend to distort the overall results. Here, extreme values refer to those responses that have a unique answer. For example, most respondents answer 6 or 7 but few answer 1. This extreme value can influence the results, and scholars have suggested treating them (Azizah & Mulyono, 2020). Although this treatment can provide good results but creates an issue of generalisability as stated by Hair et al. (2010, p. 67): *"As outliers are deleted, the researcher runs the risk of improving the multivariate analysis but limiting generalisability."*

Again, SPPS was used to identify the outliers. Only three items of pleasantness of experience construct had a critical outlier value: one case was from unsatisfied/satisfied item, whereas two cases were from annoyed/pleased item. These three cases were not treated because Kline (2011) mentioned that a few outlier cases do not create any issues. Furthermore, these three cases were used in the analysis to get good generalisability (Hair et al., 2013).

4.7.2.4 Monotone response

Another critical aspect of the data screening is the identification of monotone responses. Monotone responses are straight-lining patterns in which respondents answer only one option throughout the questionnaire(s). For instance, the respondent selects only five for all questions on a seven-point Likert scale. These responses are biased and must be identified and deleted (Hair et al., 2014). All responses from the data were screened one by one, and no monotone response was determined. Hence, a total of 227 responses were considered for the final analysis.

4.7.2.5 Normality

The normality analysis was conducted through univariate and multi variate normality tests in which the values of Skewness and Kurtosis were studied according to the guidelines provided by Mardia (1970), Yuan et al. (2005) and Cain et al. (2017). Testing for normality is considered as one of the essential criteria for multivariate data analysis. The normality curve can be of ball-shaped or symmetrical. The lower score frequency makes the right and left extremes of a curve, while the highest score frequency makes the middle part. The variable levels of skewness and kurtosis determine the normality (Hair et al., 2013). The distribution balance refers to the skewness, whereas the unbalanced distribution would be negatively or positively skewed. The flatness or peakedness of the distribution relates to the kurtosis.

Table 4.16 shows that the data are non-normal. This result is aligned with the literature because data in social sciences is usually non-normal (Bentler & Chou, 1987), and Barnes et al. (2001) mentioned that *"virtually no variable follows the normal distribution" (p. 79).* Also, the data collected through the Likert scale are usually *"skewed toward one end of the scale, uniform or even bimodal"* (Barnes et al., 2001, p. 81). Hence, the researcher used Smart PLS for the analysis because PLS-SEM provides accurate predictions with non-normal data (Cassel et al., 1999; Hair et al., 2019). Most importantly, the main objective of this research was to explain and predict the pleasantness of experience and behavioural intention. It is evident that PLS-SEM is a better alternative to CB-SEM for research related to prediction (Shiau & Chau, 2016).

Table 4.16: Univariate and multivariate normality test

Univariate skewness and kurtosis				
	Skewness	**SE_Skewness**	**Kurtosis**	**SE_Kurtosis**
ENT	-0.31	0.16	0.48	0.32
EDU	-0.037	0.16	0.84	0.32
NOV	0.35	0.16	1.28	0.32
TP	0.19	0.16	0.35	0.32
ReuseInt	-0.77	0.16	0.199	0.32
PLExp	-0.73	0.16	0.71	0.32
PurInt	0.28	0.16	-1.04	0.32
Mardia's multivariate skewness and kurtosis				
	β	***z***	***p-value***	
Skewness	7.65	289.46	5.55E-16	
Kurtosis	89.97	5.94	2.79E-09	

Note: ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence; ReuseInt, reuse intention; PLExp, pleasantness of experience; PurInt, purchase intention; SE, standard error

4.8 Summary

A mixed-method research paradigm is suitable for this research in which interviews are conducted from the visitors of VRlab at Deutsches Museum Munich, Germany. Several gratifications for using multi-sensory VR at Deutsches Museum are identified from these interviews. Afterwards, questionnaires are designed using extant research, and all constructs are categorised as reflective. A total of 227 sample is used for the analysis, supported by the literature and the statistical tools.

CHAPTER 5: RESULTS

5.1 Introduction

The analysis and results were reported according to the latest guidelines provided by the researchers (Cheah et al., 2019; Hair et al., 2019; Sharma et al., 2019; Shmueli et al., 2019). Initially, data screening was conducted. Afterwards, a two-stage analytical method was adopted after the data screening. The first stage deals with the measurement model to assess the reliability and validity of the questionnaire. The structural model's second stage was evaluated to assess the hypothesised relationships.

A total of 356 visitors showed a willingness to participate in this study and filled out the pre usage questionnaire. Out of these 356 respondents, 91 respondents did not experience VR for 15 minutes, did not watch all four VR contents, or did not answer the post usage questionnaire. Hence, only 265 experienced VR for 15 minutes, watched all four VR contents and answered the second questionnaire. Further, 38 responses were deleted because the respondents' age was less than 18 years. Consequently, 227 responses were considered for the final analysis.

5.2 Demographics

Table 5.1 provides a summary of the respondent's profiles. Out of 227 respondents, 120 were male, and 107 were female. Age of the respondents ranged from 18 to 71, with an average age of 38.08 years. The respondents of both genders and all age groups were equally interested in VR. A total of 87 respondents were familiar with multi-sensory VR, whereas many respondents were unfamiliar with it. The respondents' education was measured according to the diverse education system of Germany.

Table 5.1: Sample demographics

	Total *n*=227	%
Age in years		
Average age	38.08	
Range	18 to 71	
Gender		
Male	120	52.8
Female	107	47.2
VR familiarity		
Yes	87	38.3
No	140	61.7
Education		
Still in school	18	7.92
General qualification for university entrance	18	7.92
Intermediate secondary school certificate	12	5.28
Lower secondary school certificate	1	0.44
Certificate of a polytechnic secondary school	6	2.64
Certificate of a special-needs school	4	1.76
School left without certificate	3	1.32
Did not attend school	1	0.44
Doctorate	13	5.72
University Degree	99	43.61
Applied science university degree (FH)	18	7.92
College degree	18	7.92
Completed apprenticeship or certificate of a commercial school	16	7.04

5.3 Gratifications fulfilment and familiarity

Recently, Chiao et al. (2018) conducted research in the context of VR and tourism. They compared the pre-test and post-test scores for learning differences through paired samples t-test. Hence, to understand the fulfilment of gratifications, this research also calculated the paired t-tests on the items of GS and GO using SPSS (see Table 5.2) by following (Gaur & Gaur, 2009). The GO of education, novelty, and telepresence exceeded the GS, resulting in over fulfilling GS (GO > GS). On the contrary, only GO from entertainment was less from GS entertainment, resulting in under fulfilment of GS (GO < GS). While Table 5.3 highlights the change in familiarity due to VR. Interestingly, there was a drastic change in pre and post usage familiarities. It explained an essential phenomenon that the respondents preferred to get education from VR, and it is a good tool to provide education during tourism activities. Table 5.4

provides the correlation of change in familiarity for all four VR contents with entertainment, education, novelty, telepresence and pleasantness of experience.

Table 5.2: Comparing pre-experience and post-experience scores for the fulfilment of gratifications

	Sought		Obtained		Paired T-Tests		
	M	SD	M	SD	Difference	T (df=226)	P
Entertainment	5.71	1.28	5.16	1.64	-0.55	-5.08	.000
Education	4.91	1.40	5.68	1.19	0.77	7.09	.000
Novelty	5.41	1.27	5.77	1.12	0.37	4.08	.000
Telepresence	4.22	1.48	4.84	1.42	0.62	5.91	.000

Note: M, mean; SD, standard

Table 5.3: Comparing pre-experience and post-experience scores for the difference in familiarity

	Pre-Usage Familiarity		Post-Usage Familiarity		Paired T-Tests		
	M	SD	M	SD	Difference	T (df=226)	P
Otto Lilienthal	4.45	2.26	6.10	1.28	1.65	12.12	.000
Sulzer Steam Engine	3.05	1.98	5.36	1.82	2.31	16.83	.000
Apollo 17 Mission	5.05	1.82	6.25	1.05	1.20	11.02	.000
Benz Motorwagen	4.52	2.07	5.96	1.53	1.44	11.04	.000

Note: M, mean; SD, standard; Familiarity was measured on a scale from -3 to +3. It was converted to 1 to 7 for this table

Table 5.4: Correlations

	Correlations: Δ Familiarity with…									
	Pleasantness		Entertainment		Education		Novelty		Telepresence	
	r	P	r	P	r	P	r	P	r	P
Otto Lilienthal	.094	.158	-.114	.085	.118	.076	.080	.228	.099	.137
Sulzer Steam Engine	**.242**	**.000**	-.083	.214	**.332**	**.000**	.013	.846	.061	.358
Apollo 17 Mission	.118	.077	.079	.237	.085	.203	.020	.768	-.073	.274
Benz Motorwagen	**.169**	**.011**	-.123	.063	**.309**	**.000**	.081	.222	.075	.262

5.6 Measurement model evaluation

Reporting the factor loadings, internal consistency reliability, convergent validity, and discriminant validity for reflective measurement model evaluation is

necessary (Diamantopoulos & Winklhofer, 2001; Hair et al., 2019). The following section discusses them individually.

5.6.1 Factor loadings

The first stage of assessing the reflective measurement model is examining the factor loadings. Hair et al. (2019, p. 11) recommended to use only those items that have loadings more than 0.708 because it *"indicate that the construct explains more than 50 percent of the indicator's variance, thus providing acceptable item reliability".* All values of factor loadings (see Table 5.5) were more than the threshold of 0.708.

Table 5.5: Factor loadings

Items/constructs	Mean	SD	Factor Loadings
GS-Entertainment*			
…I will have fun	5.94	1.41	0.928
…I will enjoy	5.70	1.42	0.937
…I will be entertained	5.80	1.46	0.893
GS-Education*			
…I will learn something new	5.43	1.55	0.802
…I will become more knowledgeable	5.08	1.59	0.835
…it will stimulate my curiosity to learn new things	5.04	1.66	0.931
…it will provide a good experience for learning	4.80	1.77	0.907
GS-Novelty*			
…its experience will be unusual	5.63	1.58	0.762
…its interface will be different	5.30	1.45	0.838
…it will be something new	5.79	1.48	0.891
…this technology will be innovative	5.86	1.31	0.885
GS-Telepresence*			
…I will forget where I am	4.16	1.83	0.787
…I will visit a new world created by VR	5.17	1.80	0.746
…I will escape from the reality	4.12	1.89	0.881
...the world generated by VR will be more real for me	3.72	1.96	0.761
GO-Entertainment**			
…I got fun	5.56	1.65	0.964
…I got enjoyment	5.26	1.71	0.950
…I got entertainment	5.61	1.68	0.947
GO-Education**			
…I learned something new	5.58	1.58	0.905
…I became more knowledgeable	5.34	1.65	0.915
VR stimulated my curiosity to learn new things	5.55	1.51	0.813
VR provided a good experience for learning	5.82	1.40	0.864
GO-Novelty**			
VR experience was unusual	5.75	1.40	0.770
VR interface was different	5.66	1.30	0.790
VR experience was something new	5.99	1.26	0.847
VR technology was innovative	5.90	1.30	.911
GO-Telepresence**			
…I forgot where I am	4.39	1.90	0.783
…I visited a new world created by it	5.66	1.51	0.786

…I escaped from the reality	4.75	1.89	0.913
…the world generated by VR was more real for me	3.84	1.95	0.707
Pleasantness of Experience* **			
…unhappy/happy	1.69	1.12	0.872
…unsatisfied/satisfied	1.54	1.16	0.867
…bored/relaxed	1.13	1.43	0.796
…annoyed/pleased	1.55	1.30	0.824
Reuse Intention			
I intend to use this VR in the future	4.92	1.83	0.857
This VR is worthy of use	5.58	1.50	0.908
I will recommend this VR to other people	5.64	1.53	0.915
Purchase Intention			
I am very likely to buy this VR technology	3.35	1.97	0.979
I would consider buying this VR technology in the future	3.85	2.06	0.944
I intend to buy this VR technology	3.28	2.10	0.961

Note: GS, gratifications sought; GO, gratifications obtained; *j*, user's personal importance; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence; SD, standard deviation

*When using this VR, I expect that…
**By using Virtual Reality…
***VR experience made me…

5.6.2 Internal consistency reliability

The second step is to assess internal consistency reliability. In academic literature, composite reliability provided by Jöreskog (1971) is widely used. Higher composite reliability values represent higher internal consistencies such as 0.70 to 0.90 values are considered "satisfactory to good", and composite reliability values from 0.60 to 0.70 are "*acceptable in exploratory research".* Another way to measure internal consistency reliability is Cronbach's alpha, which produces lower values as compared to composite reliability and *"is a less precise measure of reliability since the items are unweighted"* (Hair et al., 2019, p. 11). Despite the lacking in Cronbach's alpha, this research used both approaches to assess internal consistency reliability. The values of composite reliability and Cronbach's alpha (see Table 5.6) of all constructs were more than the threshold (Hair, Sarstedt, Ringle, et al., 2012).

5.6.3 Convergent validity

The third step of measurement model evaluation is to examine the convergent validity of all variables. Convergent validity is the *"extent to which the construct converges in order to explain the variance of its items"* (Hair et al., 2019, p. 12).

Average variance extracted (AVE) is a measure to calculate convergent validity. AVE can be computed by taking a square of the loadings of each item on a variable and taking the mean value. AVE values of more than 0.50 represent a good convergent validity (Bagozzi & Yi, 1988). AVE values of all variables given in Table 5.7 were more than 0.50, in line with the literature.

Table 5.6: Cronbach's Alpha and Composite Reliability

Constructs	Cronbach's Alpha	CR
GS-Entertainment	0.910	0.943
GS-Education	0.904	0.926
GS-Novelty	0.877	0.909
GS-Telepresence	0.810	0.873
GO-Entertainment	0.951	0.968
GO-Education	0.900	0.929
GO-Novelty	0.868	0.899
GO-Telepresence	0.812	0.876
Pleasantness of Experience	0.863	0.906
Reuse Intention	0.874	0.892
Purchase Intention	0.959	0.974

Note: GS, gratifications sought; GO, gratifications obtained; CR, composite reliability

Table 5.7: Convergent validity

Constructs	AVE
GS-Entertainment	0.846
GS-Education	0.757
GS-Novelty	0.715
GS-Telepresence	0.633
GO-Entertainment	0.910
GO-Education	0.766
GO-Novelty	0.691
GO-Telepresence	0.641
Pleasantness of Experience	0.707
Reuse Intention	0.799
Purchase Intention	0.925

Note: GS, gratifications sought; GO, gratifications obtained; AVE, average variance extracted

The fourth and last step of measurement model evaluation is discriminant validity. It explains to what extent a variable is distinct from other variables. Fornell and Larcker (1981) criterion was the mostly used method until 2015 when Henseler et al. (2015) proposed a new way to measure discriminant validity and named it as a

heterotrait-monotrait (HTMT) criteria. Fornell and Larcker (1981) suggested that AVE of each variable must be compared to the square of inter-variable correlation of that same variable and all other reflective variables, and the resulting value must be less than their AVEs. Henseler et al. (2015) stated some drawbacks of Fornell and Larcker method, and proposed HTMT to overcome those drawbacks. HTMT was defined as *"the mean value of the item correlations across constructs (i.e., the heterotrait-heteromethod correlations) relative to the (geometric) mean of the average correlations for the items measuring the same construct (i.e., the monotrait-heteromethod correlations)"* (Hair et al., 2019, p. 13). Henseler et al. (2015) suggested a threshold value of 0.85. This research used both criteria to examine the discriminant validity; thus, values given in Tables 5.8 and 5.9 met the Fornell and Larcker (1981) and HTMT threshold criteria of 0.85. Hence, satisfying all four criteria of a good measurement model.

Table 5.8: Fornell and Larcker test

	GOEDU	GOENT	GONOV	GOTP	GSEDU	GSENT	PLExp	GSNOV	ReuseInt	GSTP	PurInt
GOEDU	0.862										
GOENT	0.174	0.96									
GONOV	0.314	0.309	0.8								
GOTP	0.331	0.143	0.356	0.828							
GSEDU	0.222	0.247	0.2	0.086	0.881						
GSENT	0.09	0.37	0.23	0.091	0.418	0.933					
PLExp	0.388	0.277	0.161	0.372	0.111	0.104	0.863				
GSNOV	0.142	0.318	0.407	0.177	0.4	0.333	0.17	0.877			
ReuseInt	0.479	0.2	0.347	0.488	0.133	0.141	0.494	0.25	0.908		
GSTP	0.168	-0.008	0.031	0.427	0.132	0.1	0.192	0.209	0.237	0.833	
PurInt	0.302	0.195	0.098	0.332	0.086	0.1	0.455	0.162	0.507	0.275	0.96

Note: ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence; ReuseInt, reuse intention; PLExp, pleasantness of experience; PurInt, purchase intention

Table 5.9: HTMT test

	GOEDU	GOENT	GONOV	GOTP	GSEDU	GSENT	PLExp	GSNOV	ReuseInt	GSTP	PurInt
GOEDU											
GOENT	0.184										
GONOV	0.326	0.245									
GOTP	0.371	0.151	0.352								
GSEDU	0.228	0.265	0.17	0.102							
GSENT	0.123	0.4	0.247	0.101	0.442						
PLExp	0.424	0.288	0.104	0.419	0.123	0.113					
GSNOV	0.158	0.346	0.421	0.189	0.434	0.369	0.183				
ReuseInt	0.54	0.222	0.311	0.551	0.142	0.162	0.546	0.269			
GSTP	0.195	0.106	0.129	0.475	0.196	0.168	0.196	0.283	0.258		
PurInt	0.321	0.199	0.095	0.375	0.09	0.104	0.49	0.152	0.541	0.289	

Note: ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence; ReuseInt, reuse intention; PLExp, pleasantness of experience; PurInt, purchase intention

5.7 Analysis 1

This research compared different models used in the literature to study gratifications. The values of coefficient determinant-R^2 were considered as a primary standard in explaining the pleasantness of experience (see Table 5.17) and a secondary standard by comparing the error terms of different models (see Table 5.18). Anderson-Sprecher (1994) and Saunders et al. (2012) suggested comparing models through R^2, and another recent approach presented by Sharma et al. (2019) to compare different models based on error terms.

The values of R^2 were taken through the SEM. The reason for using SEM is its robustness and comprehensiveness for estimating the parameters and testing the hypothesis. SEM is better than first generation or traditional multivariate methods such as ANOVA and regression analysis. Because SEM is capable of estimating multiple relationships among constructs, whereas traditional methods can only analyse one relationship at a time. By using SEM, researchers can get an accurate prediction and estimation by considering constructs' measurement errors. Moreover, the dependent variable can also act as an independent variable in other relationship[s] (Haenlein & Kaplan, 2004).

The R^2 values range from 0 to 1. A higher value close to 1 shows a greater explanatory power. The researchers categorised R^2 values as 0.25, 0.50, and 0.75, representing weak, moderate, and substantial explanatory power. R^2 values of 0.90 and higher typically over fit (Hair, Ringle, et al., 2011; Henseler et al., 2009).

Sharma et al. (2019) argued that R^2 is not enough to compare the models. *"Instead, model selection criteria – in particular, the Bayesian information criterion (BIC) and the Geweke-Meese criterion (GM) – should be used due to their high model selection accuracy and ease of use"* (p. 346). They further argued that *"these criteria*

allow researchers to compare alternative models and select a parsimonious yet well-fitting model" (p. 346) to identify the best model after comparing the competing models. Other researchers also supported these criteria (Cheah et al., 2019). According to these criteria, asymptotical efficiency includes Akaike's (1970) final prediction error (FPE), Mallow's Cp (Mallows, 1973), Akaike's (1973) information criterion (AIC), Sugiura's (1978) corrected AIC (AICc), and McQuarrie and Tsai's (1998) unbiased AIC (AICu). Contrary, asymptotical consistency includes Schwarz's (1978) Bayesian information criterion (BIC), Geweke and Meese's (1981) criterion (GM), Hannan and Quinn's (1979) criterion (HQ), and McQuarrie and Tsai's (1998) corrected HQ criterion (HQc). These criteria can identify the model that is parsimonious and consistent with reality (or fits the data satisfactorily). Thus, improving the generalisability of the findings to other samples (Sharma et al., 2019). The smaller the values of these criteria, the better the model is in terms of model fit and model parsimony (McQuarrie & Tsai, 1998).

5.7.1 Model zero

Initially, the researcher used all control variables (Model 0) to get the basic R^2 which was 0.076 (see figure 5.1). The R^2 of other models was compared to this R^2 to know about those models' predicting power.

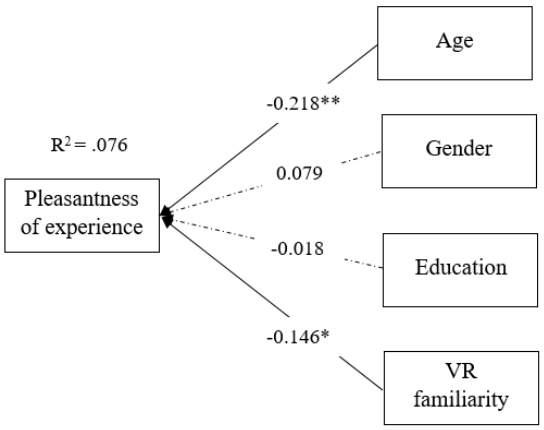

Figure 5.1: Results of model zero with control variables

5.7.2 Model 1

Model 1 was comprised of the gratifications sought ∑(GS) constructs. This model produced R^2 values of 0.128 with a change of 0.052 from the control model (see figure 5.2). The comparison of R^2 values for all models is given in table 5.17.

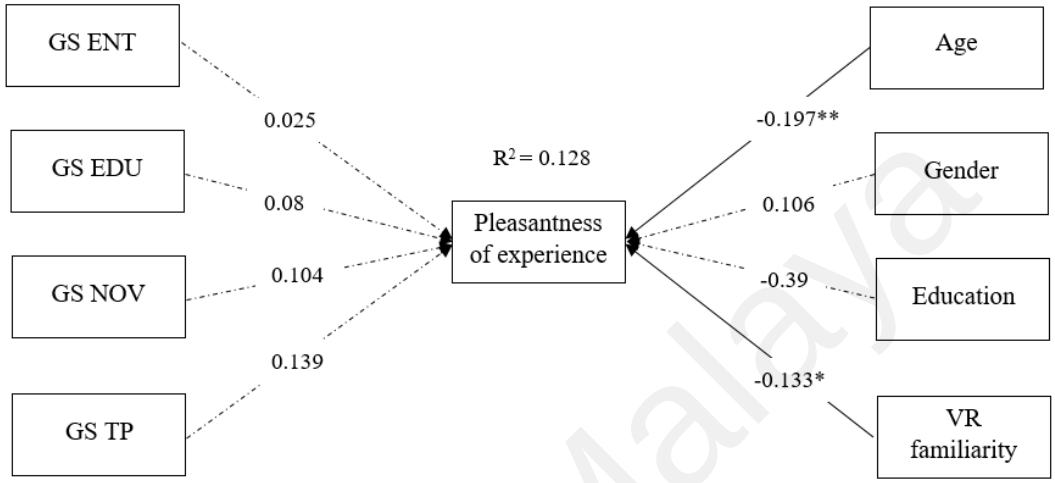

Figure 5.2: Results of model 1 with GS variables

Note: GS, gratifications sought; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

The values of asymptotical efficiency and consistency for model 1 are given in table 5.10 (Cheah et al., 2019; Sharma et al., 2019). The comparison of these criteria for all models is shown in table 5.18.

Table 5.10: Asymptotical efficiency and consistency of model 1

Criteria	Values
Asymptotical efficiency	
FPE	0.907
Mallow's Cp	9.000
AIC	-22.093
AICu	-17.038
AICc	207.288
Asymptotical consistency	
BIC	-4.969
GM	253.125
HQ	-15.183
HQc	-14.645

Note: FPE, final prediction error; AIC, Akaike's information criterion; AICu, unbiased AIC; AICc, corrected AIC; BIC, Bayesian information criterion; GM, Geweke and Meese's criterion; HQ, Hannan and Quinn's criterion; HQc, corrected HQ criterion

5.7.3 Model 2

The second model was the gratifications obtained model ∑(GO), which provided the R^2 values of 0.302 with a change of 0.226 from the basic model (see figure 5.3).

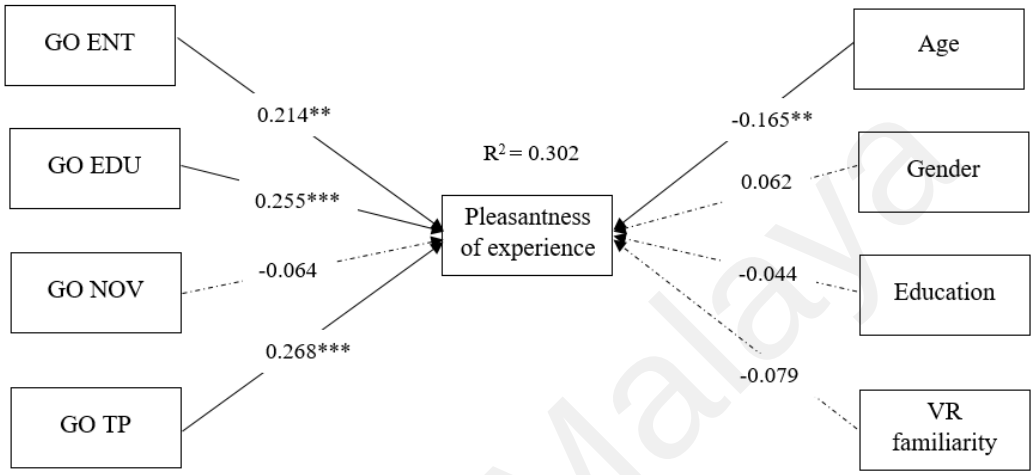

Figure 5.3: Results of model 2 with GO variables

Note: GO, gratifications obtained; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

The values of asymptotical efficiency (AICc, AICu, AIC, FPE, and Mallow's Cp) and consistency (BIC, GM, HQc, and HQ) for model 2 are given in table 5.11 (Cheah et al., 2019; Sharma et al., 2019).

Table 5.11: Asymptotical efficiency and consistency of model 2

Criteria	Values
Asymptotical efficiency	
FPE	0.726
Mallow's Cp	9.000
AIC	-72.617
AICu	-67.561
AICc	156.765
Asymptotical consistency	
BIC	-55.492
GM	253.125
HQ	-65.707
HQc	-65.169

Note: FPE, final prediction error; AIC, Akaike's information criterion; AICu, unbiased AIC; AICc, corrected AIC; BIC, Bayesian information criterion; GM, Geweke and Meese's criterion; HQ, Hannan and Quinn's criterion; HQc, corrected HQ criterion

5.7.4 Model 3

The third model was the simplified discrepancy model ∑(GO - GS), which provided the R^2 values of 0.190 with a change of 0.106 from the basic model (see figure 5.4).

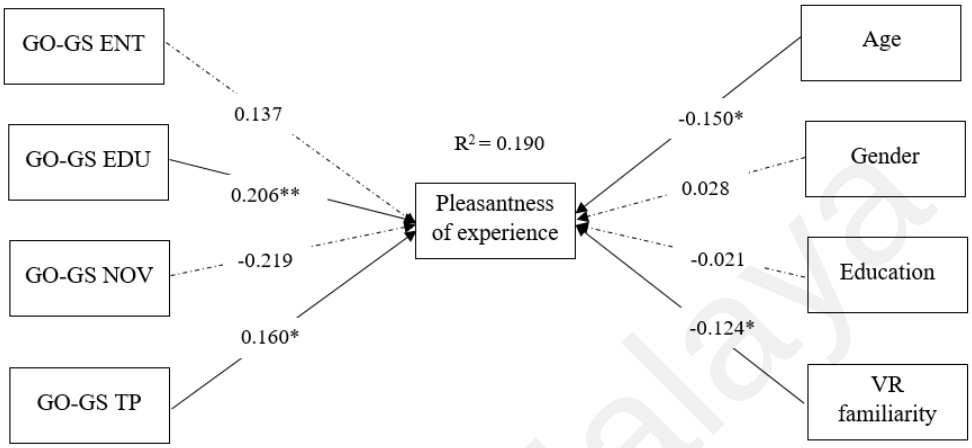

Figure 5.4: Results of model 3 with GO-GS variables

Note: GS, gratifications sought; GO, gratifications obtained; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

The values of asymptotical efficiency (AICc, AICu, AIC, FPE, and Mallow's Cp) and consistency (BIC, GM, HQc, and HQ) for model 3 are given in table 5.12 (Cheah et al., 2019; Sharma et al., 2019).

Table 5.12: Asymptotical efficiency and consistency of model 3

Criteria	Values
Asymptotical efficiency	
FPE	0.843
Mallow's Cp	9.000
AIC	-38.836
AICu	-33.780
AICc	190.546
Asymptotical consistency	
BIC	-21.711
GM	253.125
HQ	-31.926
HQc	-31.388

Note: FPE, final prediction error; AIC, Akaike's information criterion; AICu, unbiased AIC; AICc, corrected AIC; BIC, Bayesian information criterion; GM, Geweke and Meese's criterion; HQ, Hannan and Quinn's criterion; HQc, corrected HQ criterion

5.7.5 Model 4

The fourth model was the expectancy-value discrepancy model $\sum j(\text{GO - GS})$, which produced the R^2 values of 0.162 with a change of 0.086 from model zero (see figure 5.5).

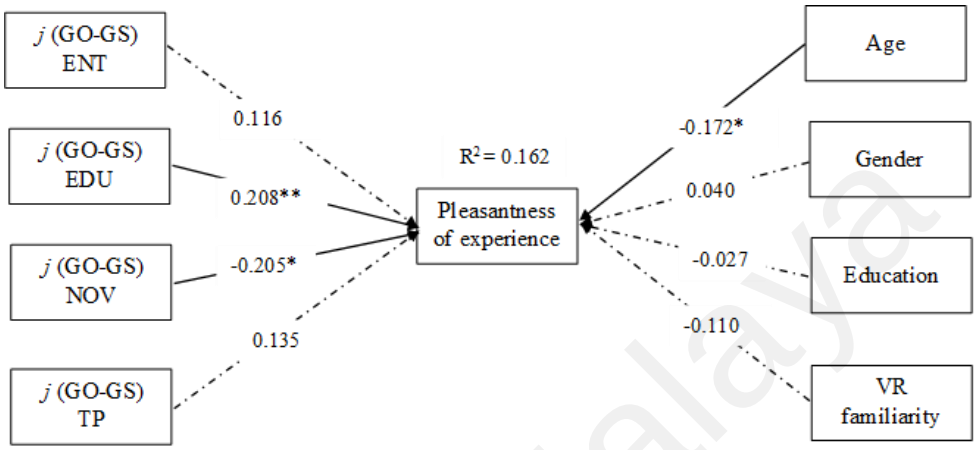

Figure 5.5: Results of model 4 with *j* (GO-GS) variables

Note: GS, gratifications sought; GO, gratifications obtained; *j*, user's personal importance; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

The values of asymptotical efficiency (AICc, AICu, AIC, FPE, and Mallow's Cp) and consistency (BIC, GM, HQc, and HQ) for model 4 are given in table 5.13 (Cheah et al., 2019; Sharma et al., 2019).

Table 5.13: Asymptotical efficiency and consistency of model 4

Criteria	Values
Asymptotical efficiency	
FPE	0.872
Mallow's Cp	9.000
AIC	-31.122
AICu	-26.066
AICc	198.260
Asymptotical consistency	
BIC	-13.997
GM	253.125
HQ	-24.211
HQc	-23.673

Note: FPE, final prediction error; AIC, Akaike's information criterion; AICu, unbiased AIC; AICc, corrected AIC; BIC, Bayesian information criterion; GM, Geweke and Meese's criterion; HQ, Hannan and Quinn's criterion; HQc, corrected HQ criterion

5.7.6 Model 5

The fifth model was a transactional model ∑(GS+GO) that produced R^2 values of 0.238 with a change of 0.162 from model zero (see figure 5.6).

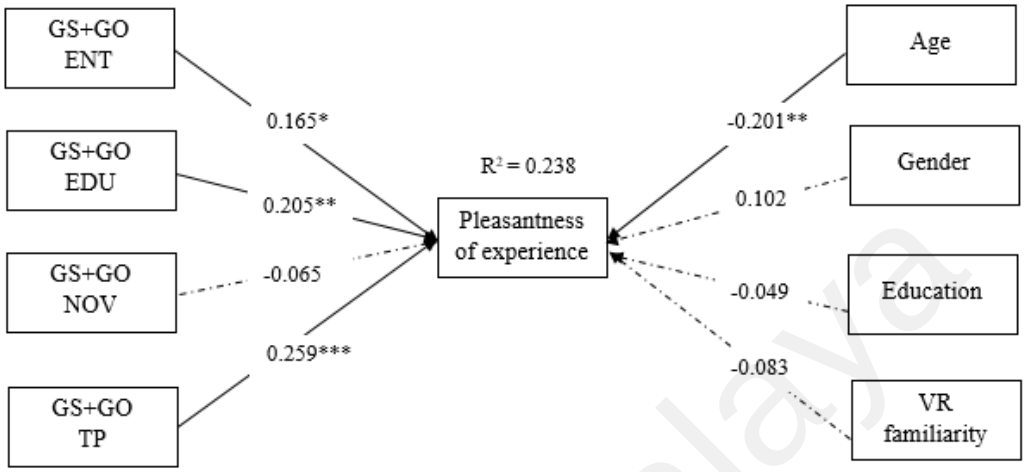

Figure 5.6: Results of model 5 with GS+GO variables

Note: GS, gratifications sought; GO, gratifications obtained; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

The values of asymptotical efficiency (AICc, AICu, AIC, FPE, and Mallow's Cp) and consistency (BIC, GM, HQc, and HQ) for model 5 are given in table 5.14 (Cheah et al., 2019; Sharma et al., 2019).

Table 5.14: Asymptotical efficiency and consistency of model 5

Criteria	Values
Asymptotical efficiency	
FPE	0.793
Mallow's Cp	9.000
AIC	-52.703
AICu	-47.647
AICc	176.679
Asymptotical consistency	
BIC	-35.578
GM	253.125
HQ	-45.793
HQc	-45.255

Note: FPE, final prediction error; AIC, Akaike's information criterion; AICu, unbiased AIC; AICc, corrected AIC; BIC, Bayesian information criterion; GM, Geweke and Meese's criterion; HQ, Hannan and Quinn's criterion; HQc, corrected HQ criterion

5.7.7 Model 6

The sixth model was also a transactional model $\sum j$(GS+GO), which gave the R^2 values of 0.181 with a change of 0.105 from the basic model (see figure 5.7).

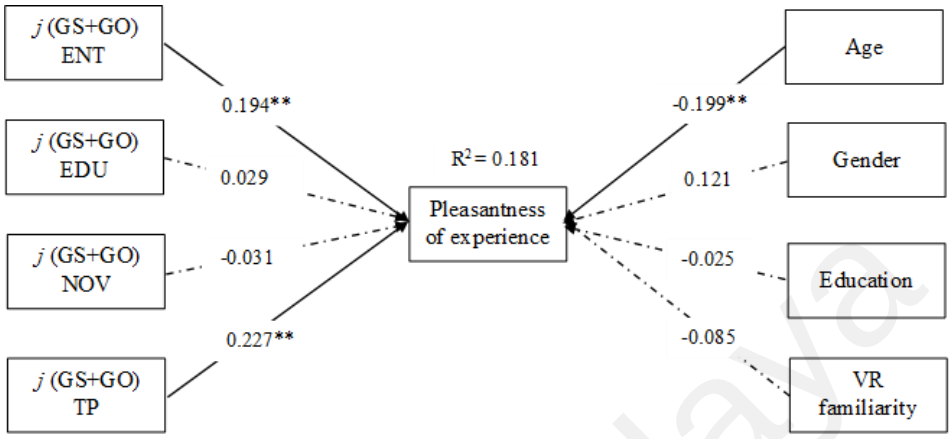

Figure 5.7: Results of model 6 with *j* (GS+GO) variables

Note: GS, gratifications sought; GO, gratifications obtained; *j*, user's personal importance; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

The values of asymptotical efficiency (AICc, AICu, AIC, FPE, and Mallow's Cp) and consistency (BIC, GM, HQc, and HQ) for model 6 are given in table 5.15 (Cheah et al., 2019; Sharma et al., 2019).

Table 5.15: Asymptotical efficiency and consistency of model 6

Criteria	Values
Asymptotical efficiency	
FPE	0.852
Mallow's Cp	9.000
AIC	-36.328
AICu	-31.272
AICc	193.054
Asymptotical consistency	
BIC	-19.203
GM	253.125
HQ	-29.417
HQc	-28.879

Note: FPE, final prediction error; AIC, Akaike's information criterion; AICu, unbiased AIC; AICc, corrected AIC; BIC, Bayesian information criterion; GM, Geweke and Meese's criterion; HQ, Hannan and Quinn's criterion; HQc, corrected HQ criterion

5.7.8 Model 7

The seventh and last model was modified gratifications obtained model $\sum j(\text{GO})$ that yielded R^2 values of 0.225 with a change of 0.149 (see figure 5.8).

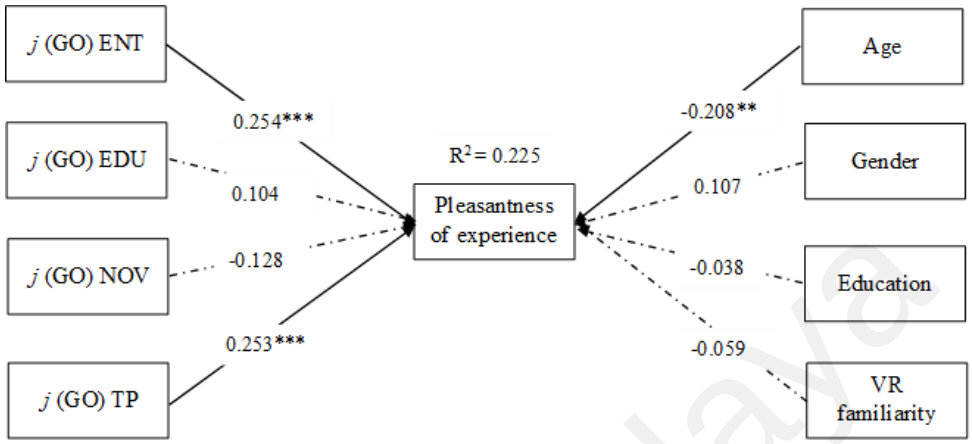

Figure 5.8: Results of model 7 with *j* (GO) variables

Note: GO, gratifications obtained; *j*, user's personal importance; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence

The values of asymptotical efficiency (AICc, AICu, AIC, FPE, and Mallow's Cp) and consistency (BIC, GM, HQc, and HQ) for model 7 are given in table 5.16 (Cheah et al., 2019; Sharma et al., 2019).

Table 5.16: Asymptotical efficiency and consistency of model 7

Criteria	Values
Asymptotical efficiency	
FPE	0.806
Mallow's Cp	9.000
AIC	-48.863
AICu	-43.807
AICc	180.519
Asymptotical consistency	
BIC	-31.738
GM	253.125
HQ	-41.953
HQc	-41.415

Note: FPE, final prediction error; AIC, Akaike's information criterion; AICu, unbiased AIC; AICc, corrected AIC; BIC, Bayesian information criterion; GM, Geweke and Meese's criterion; HQ, Hannan and Quinn's criterion; HQc, corrected HQ criterion

5.7.9 Summary of analysis 1

All models provided R^2 values more than model zero (see table 5.17), but model 2 provided the best R^2 value (0.302). In the same way, model 2 provided the lowest error terms of asymptotical efficiency and consistency (see table 5.18). The smaller values of these criteria represent the better model in terms of model fit and model parsimony (McQuarrie & Tsai, 1998). This improves the generalisability of the findings to other samples (Sharma et al., 2019). Therefore, this research used model 2 to investigate the role of nuanced gratifications on behavioural intention.

Table 5.17: Results of all models compared through analysis 1

DV: Pleasantness of experience	*Model 0*		*Model 1*		*Model 2*		*Model 3*		*Model 4*		*Model 5*		*Model 6*		*Model 7*	
	β	*p*	β	*p*	β	*p*	β	*p*	β	*p*	β	*p*	β	*p*	β	*p*
Control Variables																
Age	**-.218**	**.001**	**-.197**	**.003**	**-.165**	**.006**	**-.150**	**.016**	**-.180**	**.004**	**-.201**	**.001**	**-.199**	**.001**	**-.208**	**.001**
Gender	.079	.203	.106	.091	.062	.302	.028	.675	.113	.067	.102	.099	.121	.064	.107	.101
Education	-.018	.785	-.39	.549	-.044	0.38	-.021	.740	-.020	.76	-.049	.386	-.025	.684	-.038	.548
Familiarity with VR	**-.146**	**.019**	**-.133**	**.04**	-.079	.174	**-.124**	**.047**	-.116	.058	-.083	.156	-.085	.170	-.059	.259
Gratifications Sought																
Entertainment			.025	.790												
Education			.08	.190												
Novelty			.104	.352												
Telepresence			.139	.144												
Gratifications Obtained																
Entertainment					**.214**	**.004**										
Education					**.255**	**.000**										
Novelty					-.064	.587										
Telepresence					**.268**	**.000**										
Differences (obtained – sought)																
Δ Entertainment							.137	.062								
Δ Education							**.206**	**.003**								
Δ Novelty							-.219	.138								
Δ Telepresence							**.160**	**.027**								

Discrepancy x Importance								
Δ Entertainment x importance				.116	.145			
Δ Education x importance				**.208**	**.004**			
Δ Novelty x importance				**-.205**	**.007**			
Δ Telepresence x importance				.135	.090			
Obtained + Sought								
Entertainment						**.165**	**.024**	
Education						**.205**	**.001**	
Novelty						-.065	.355	
Telepresence						**.259**	**.000**	
(Obtained + Sought) x Importance								
Entertainment							**.194**	**.002**
Education							.029	.638
Novelty							-.031	.663
Telepresence							**.227**	**.004**
Importance x (Obtained)								
Entertainment								**.254**
Education								.104
Novelty								-.128
Telepresence								**.253**
R-Square	.076	.128	.302	.190	.162	.238	.181	.225
R-Square Changed		.052	.226	.114	.086	.162	.105	.149

Table 5.18: Asymptotical efficiency and consistency criteria for all models

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
FPE	0.907	0.726	0.843	0.872	0.793	0.852	0.806
Mallow's Cp	9.000	9.000	9.000	9.000	9.000	9.000	9.000
AIC	-22.093	-72.617	-38.836	-31.122	-52.703	-36.328	-48.863
AICu	-17.038	-67.561	-33.780	-26.066	-47.647	-31.272	-43.807
AICc	207.288	156.765	190.546	198.260	176.679	193.054	180.519
BIC	-4.969	-55.492	-21.711	-13.997	-35.578	-19.203	-31.738
GM	253.125	253.125	253.125	253.125	253.125	253.125	253.125
HQ	-15.183	-65.707	-31.926	-24.211	-45.793	-29.417	-41.953
HQc	-14.645	-65.169	-31.388	-23.673	-45.255	-28.879	-41.415

Note: GO, gratifications obtained; *j*, user's personal importance; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence; FPE, final prediction error; AIC, Akaike's information criterion; AICu, unbiased AIC; AICc, corrected AIC; BIC, Bayesian information criterion; GM, Geweke and Meese's criterion; HQ, Hannan and Quinn's criterion; HQc, corrected HQ criterion

5.8 Analysis 2

In this sub-section, structural model evaluation and hypotheses tests of analysis 2 are discussed. The model in the current study used gratifications obtained constructs that yielded the best R^2 among all other models and the lowest error terms of asymptotical efficiency and consistency. As discussed earlier, items used in this study showed good reliability and validity. Therefore, SEM and hypotheses tests can be conducted further. The suitable criteria for assessing the structural model are variance inflation factor (VIF) values, R^2, the blindfolding-based measure Q^2, and PLS-predict (Hair et al., 2019). Therefore, the preceding section discusses all of these criteria.

5.8.1 Structural model evaluation and hypotheses tests

The data were calculated by connecting all latent variables with 5,000 iterations of the bootstrapping and using bias-corrected and accelerated (BCa) approach. Table 5.19 presents the inner variance inflation factor (VIF) values of all constructs within the range of 1.076 to 1.359. All values were below 3, which indicated that collinearity between constructs was not an issue (Becker et al., 2015).

Table 5.19: Lateral collinearity assessment

	ReuseInt	PLExp	PurInt
ENT		1.114	
EDU		1.189	
NOV		1.290	
TP		1.220	
ReuseInt			1.359
PLExp	1.076		1.076

Note: ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence; ReuseInt, reuse intention; PurInt, purchase intention; PLExp, pleasantness of experience

The central criterion to assess the structural model was R^2 of the endogenous constructs such as PLExp, ReuseInt, and PurInt (Henseler et al., 2012). The R^2 values range from 0 to 1. A higher value close to 1 shows a greater explanatory power. The researchers categorised R^2 values as 0.25, 0.50, and 0.75, representing weak, moderate, and substantial explanatory power. The R^2 values of 0.259 for PLExp, 0.263 for ReuseInt, and 0.224 for PurInt (Table 5.20) overall showed a moderate predictive power of a model.

Table 5.20: Coefficient determinant R^2

	R^2	Categorisation
ReuseInt	0.263	Moderate
PLExp	0.259	Moderate
PurInt	0.224	Weak

Note: ReuseInt, reuse intention; PurInt, purchase intention; PLExp, pleasantness of experience

Another criterion to assess the structural model is to evaluate the values of Q^2 through the blindfolding procedure (Chin, 1998; Henseler et al., 2012). The Q^2 values must be larger than zero to demonstrate the model's predictive ability. As a guideline, Q^2 values represents:

- $0 \leq Q^2 \leq 0.15$ = weak effect
- $0.15 \leq Q^2 \leq 0.35$ = Medium effect
- $Q^2 \geq 0.35$ = Strong effect

The Q^2 values of 0.208 for ReuseInt, 0.179 for PLExp, and 0.201 for PurInt showed a medium predictive ability (see Table 5.21).

Table 5.21. Blindfolding-based measure Q^2

	SSO	SSE	Q^2 (=1-SSE/SSO)	Categorisation
ReuseInt	681	539.384	0.208	Medium
PLExp	908	745.560	0.179	Medium
PurInt	681	544.403	0.201	Medium

Note: ReuseInt, reuse intention; PurInt, purchase intention; PLExp, pleasantness of experience

The criteria mentioned above were not enough to evaluate the model's predictive power, because it does not explain the model's out of sample predictive ability (Dolce et al., 2017; Hair et al., 2019; Shmueli & Koppius, 2011). Shmueli et al. (2016) proposed PLSpredict procedure to measure the out of sample prediction through cross-validation with holdout samples. The researcher also ran the PLSpredict to get the prediction error, such as the mean absolute error (MAE) and the root mean square error-RMSE (Shmueli et al., 2019). The model showed a medium predictive power (see Table 5.22) because PLS estimates were less than the corresponding LM estimates of a few cases (Shmueli et al., 2019).

Table 5.22: PLSpredict assessment

	PLS		LM		Difference PLS-LM		
	RMSE	**MAE**	**RMSE**	**MAE**	**RMSE**	**MAE**	
ReuseInt1	1.577	1.294	1.488	1.327	0.089	-0.033	**Medium Predictive Power**
ReuseInt2	1.314	0.971	1.473	0.985	-0.159	-0.014	
ReuseInt3	1.415	1.139	1.327	1.031	0.088	0.108	
PurInt1	1.774	1.511	1.719	1.423	0.055	0.088	
PurInt2	1.868	1.517	1.87	1.528	-0.002	-0.011	
PurInt3	1.893	1.644	1.943	1.516	-0.05	0.128	

Note: RMSE, Root Mean Square Error; MAE, Mean Absolute Error; PLS, Partial Least Squares Path Model; LM, Linear Regression Model

5.8.1.1 Hypothesis testing

On the basis of the discussion mentioned above, it was evident that the results of a proposed model were reliable and could be used to test the hypothesis. Table 5.23 provides a list of construct relationships, path coefficients, p-values, and support/rejection of the hypothesis.

The results given in figure 5.9 showed a positive and significant impact of GO ENT → PLExp (H1: 0.216; p=0.002), supporting H1. The relationship between GO EDU → PLExp (H2: 0.288; p=0.00) was positively significant, supporting H2. GO TP → PLExp (H4: 0.279; p=0.00) was also positively significant, supporting H4. The insignificant relationship between gratifications obtained and PLExp existed in the case of novelty (H3: GO NOV → PLExp, -0.096; p=0.360), rejecting H3. As predicted, PLExp positively influenced the behavioural intentions such as PLExp → ReuseInt (H5a: 0.490; p=0.00) and PLExp → PurInt (H5b: 0.276; p=0.00), supporting H5a and H5b. Furthermore, ReuseInt also positively influenced PurInt (H8: 0.360; p=0.00) that supported H8.

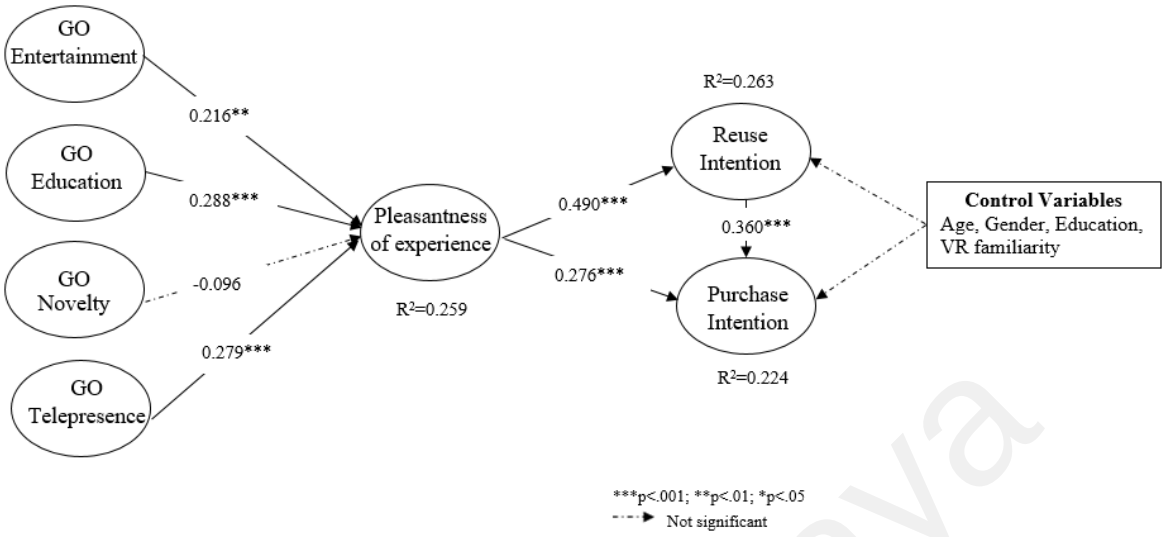

Figure 5.9: Results of analysis 2

Table 5.23: Structural model results of analysis 2

Construct Relationship	Path coefficient	Support for hypothesis
Main Model		
GO Entertainment → Pleasantness of experience	0.216**	Yes (H1)
GO Education → Pleasantness of experience	0.288***	Yes (H2)
GO Novelty → Pleasantness of experience	-0.096(ns)	No (H3)
GO Telepresence → Pleasantness of experience	0.279***	Yes (H4)
Pleasantness of experience → Reuse Intention	0.490***	Yes (H5a)
Pleasantness of experience → Purchase Intention	0.276***	Yes (H5b)
Reuse Intention → Purchase Intention	0.360***	Yes (H8)
Mediation-Pleasantness of experience		
GO Ent → PLExp → Reuse Intention	0.106**	Yes (H6a)
GO Edu → PLExp → Reuse Intention	0.141***	Yes (H6b)
GO Nov → PLExp → Reuse Intention	-0.047(ns)	No (H6c)
GO TP → PLExp → Reuse Intention	0.137**	Yes (H6d)
GO Ent → PLExp → Purchase Intention	0.059*	Yes (H7a)
GO Edu → PLExp → Purchase Intention	0.079**	Yes (H7b)
GO Nov → PLExp → Purchase Intention	-0.026(ns)	No (H7c)
GO TP → PLExp → Purchase Intention	0.077**	Yes (H7d)

Note: *** = significant at the 0.1% level; ** = significant at the 0.5% level; * = significant at the 5% level

5.8.1.2 Mediation

A mediator variable helps in understanding the underlying mechanisms through which the independent variable influences the dependent variable. Baron and Kenny's (1986) method is a popular procedure among researchers to study mediation (see figure 5.10). They stated the following conditions for a variable to work as a mediator:

(i) variations in levels of the independent variable significantly account for variations in the presumed mediator (i.e., Path a), (ii) variations in the mediator significantly account for variations in the dependent variable (i.e., Path b), and (iii) when Paths a and b are controlled, a previously significant relation between the independent and dependent variables is no longer significant, with the strongest demonstration of mediation occurring when Path c is zero.

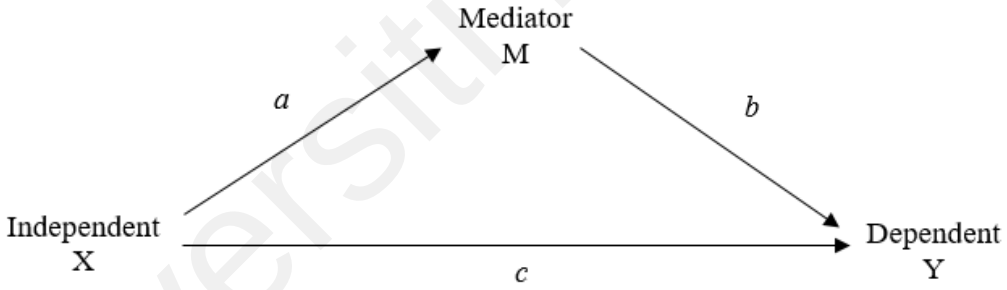

Figure 5.10: Mediation

The path a can be tested through equation= $i_1 + aX + e_1$, for path b= $i_2 + c'X + e_2$ and path c= $i_3 + cX + bM + e_3$. Firstly, they recommended regressing mediator on IV, secondly, regressing DV on IV, and thirdly, DV on both IV and mediator. Furthermore, three situations essentially hold for mediation: IV must affect the mediator in the first equation, IV must affect DV in the second equation, and the mediator must affect DV in the third

equation. To measure the indirect path of a *x* b, they recommended the Sobel *z*-test (Baron & Kenny 1986, 1176).

Later on, Zhao et al. (2010) presented summary of the drawbacks of Baron and Kenny's work by stating *"we recommend that to establish mediation the Baron-Kenny [three tests + Sobel] steps be replaced with one and only one test: the bootstrap test of the indirect effect a x b"* (p. 204). They presented the following mentioned typology of mediations and non-mediations (Zhao et al., 2010, p. 204):

i. If a x b is significant but c is not, you have indirect-only mediation.

ii. If a x b is not significant but c is, you have direct-only non-mediation.

iii. If neither a x b nor c is significant, you have no effect non-mediation.

iv. If both a x b and c are significant, determine the sign of a x b x c by multiplying the three coefficients, or by multiplying c by the mean value of a x b from the bootstrap output. If a x b x c is positive, it is complementary mediation; if a x b x c is negative, it is competitive mediation.

The visual depiction of this typology is given in figure 5.11. The mediation analysis for this research was conducted according to the guidelines provided by Zhao et al. (2010).

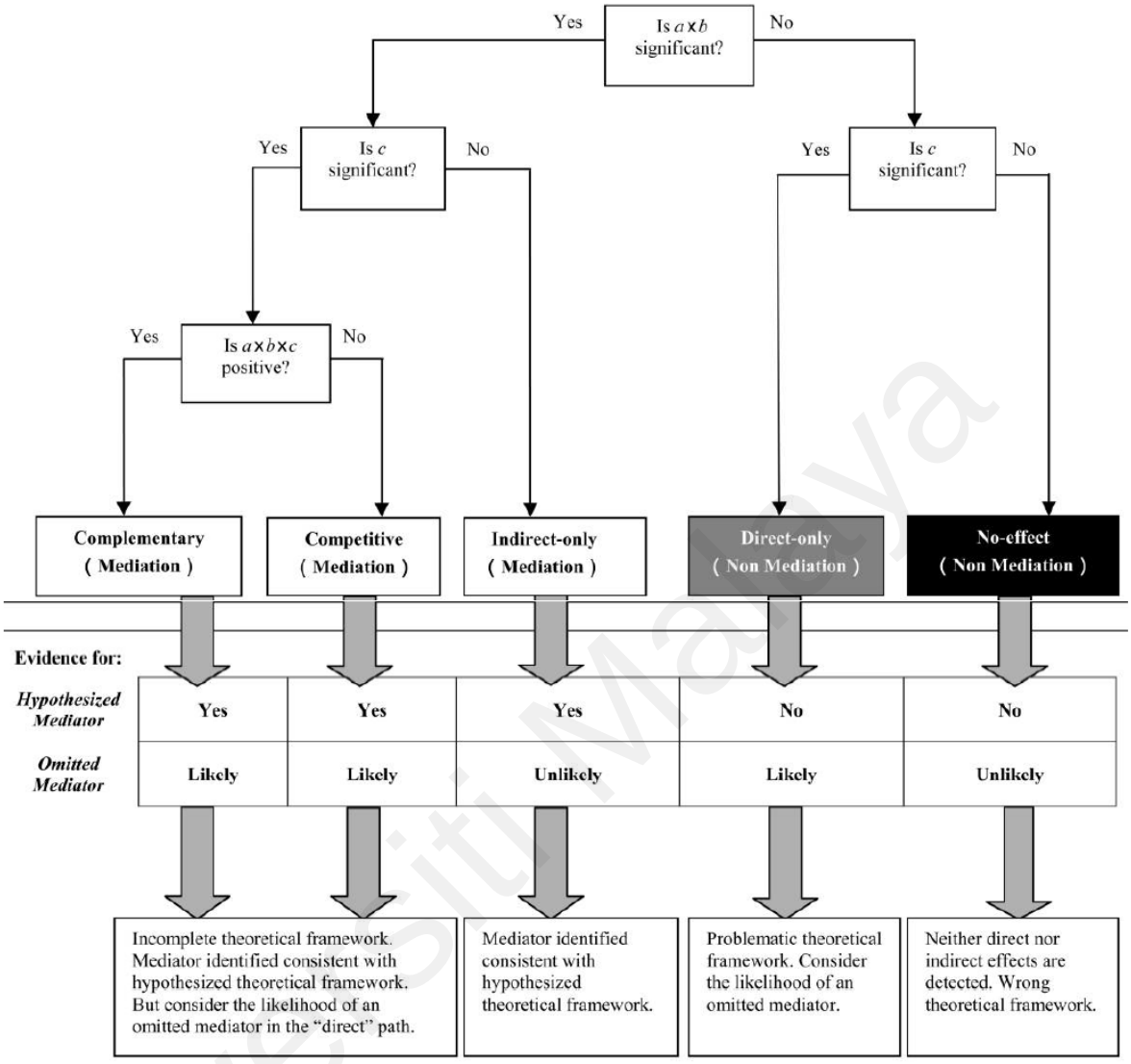

Figure 5.11: Decision tree for establishing and understanding mediation taken from Zhao et al. (2010, p.201)

The results (see Table 5.24) showed that indirect effect GO ENT → PLExp → ReuseInt (0.106; p=0.002) and direct effect GO ENT → ReuseInt (0.106; p=0.002) were significant. The significant indirect and direct paths concluded that PLExp had a complementary mediation between GO ENT and ReuseInt (supporting H6a). The indirect effect GO EDU → PLExp → ReuseInt (0.141; p=0.000) and direct effect GO EDU → ReuseInt (0.141; p=0.000) were positively significant. Hence, PLExp also played a

complementary mediating role, supporting H6b. Contrary, the indirect path GO NOV → PLExp → ReuseInt (-0.047; p=0.365) and GO NOV → ReuseInt (-0.047; p=0.365) were insignificant, showing no mediation, hence, rejecting H6c. The indirect path GO TP → PLExp → ReuseInt (0.137; p=0.001) and direct path GO TP → ReuseInt (0.137; p=0.001) were significant, showing a complementary mediation that supported H6d.

The indirect effect GO ENT → PLExp → PurInt (0.059; p= 0.033) and direct effect GO ENT → PurInt (0.098; p=0.01) were significant, showing complementary mediation (supporting H7a). The same was with the indirect effect of GO EDU → PLExp → PurInt (0.079; p=0.004) and the direct effect GO EDU → PurInt (0.13; p= 0.00), which were significant and depicted the complementary mediation by supporting H7b. However, the indirect path GO NOV → PLExp → PurInt (-0.026; p=0.408) and direct path GO NOV → PurInt (-0.043; p=0.378) were insignificant, showed no mediation, and rejected H7c. The indirect path GO TP → PLExp → PurInt (0.077; p=0.003) and direct path GO TP → PurInt (0.126; p=0.00) were significant, showing a complementary mediation and support H7d. All these complementary mediations are aligned with the academic literature because Iacobucci (2008, p.12) mentioned that *"when all tests are properly conducted and reported, the majority of articles conclude with partial mediation"*.

Table 5.24: Results of mediation

	β	Standard Error	t-values	*p*-values	BCI LL	BCI UL	Mediation
GO ENT -> PLExp -> ReuseInt	0.106	0.035	3.050	0.002	0.042	0.173	Complementary Mediation
GO EDU -> PLExp -> ReuseInt	0.141	0.036	3.909	*p*<0.001	0.072	0.211	Complementary Mediation
GO NOV -> PLExp -> ReuseInt	-0.047	0.052	0.908	0.365	-0.17	0.043	No mediation
GO TP -> PLExp -> ReuseInt	0.137	0.039	3.473	*p*<0.001	0.073	0.226	Complementary Mediation
GO ENT -> PLExp -> PurInt	0.059	0.028	2.140	0.033	0.02	0.134	Complementary Mediation
GO EDU -> PLExp -> PurInt	0.079	0.027	2.909	0.004	0.033	0.138	Complementary Mediation
GO NOV -> PLExp -> PurInt	-0.026	0.032	0.828	0.408	-0.121	0.020	No mediation
GO TP -> PLExp -> PurInt	0.077	0.026	3.003	0.003	0.037	0.143	Complementary Mediation

Note: GO, gratifications obtained; ENT, entertainment; EDU, education; NOV, novelty; TP, telepresence; PLExp, pleasantness of experience; ReuseInt, reuse intention; PurInt, purchase intention; BCI LL, confidence intervals bias-corrected at lower limit; BCI UL, confidence intervals bias-corrected at upper limit

CHAPTER 6: DISCUSSION

6.1 Introduction

The preceding chapter presented an analysis conducted according to the research objectives mentioned in Chapter 1, research gaps derived from the literature discussed in Chapter 2, and the proposed hypothesis in Chapter 3. This 6th Chapter discusses the results of the hypothesis and research findings related to the objectives.

This Chapter is divided into two sections. The first section discusses a synopsis of the whole research through the support of research objectives, whereas the second section discusses and interprets the main findings according to the proposed hypothesis.

6.2 Synopsis of research

6.2.1 Research objective 1

VR can provide a multi-sensory experience in a computerised environment by allowing one to visualise the computer-generated world, auditory feeling, smell, taste, walk, and touch. Multi-sensory experience in a virtual environment does not necessarily deal with all of them, but it depends on more than one sense (Fuchs & Reichel, 2006; Guttentag, 2010). Research on multi-sensory VR experience in tourism is at an early stage. A few scholars studied this phenomenon, including Flavián et al. (2019, 2021b), Hopf et al. (2020), Melo et al. (2022), Wen and Leung (2021). Flavián et al. (2019) conducted research by collecting data from three experimental groups with different VR sources (desktop PC, mobile phones, and VR headsets) dealing with the senses of vision and hearing only. Flavián et al. (2021b) used an additional element of scent along with the audio-visual. Hopf et al. (2020) studied haptic and olfactory experience along with the visual and auditory VR experience, whereas Wen and Leung (2021) included the taste of a

wine. Melo et al. (2022) experimented by providing two VR stimuli (audio visual vs multi-sensory). Multi-sensory VR was able to provide wind and smell along with audio visual. Still, other sensory stimuli such as taste, walking, touch, and feel of sitting are less explored.

Several gratifications are being used in the literature according to the nature of a technological medium (see Table 2.1 and section 2.2). For example, social media fulfils social needs. Hence, people seeking socialisation will prefer to use social media (Basilisco & Jin, 2015; Ha et al., 2015; Korhan & Ersoy, 2016). In the same way, Ghazali et al. (2019a, 2019b) studied gratifications (challenge, achievement, social interaction, escapism) for playing AR Pokémon games and found that challenge, achievement, and social interaction positively influence enjoyment that ultimately affects continuance intention to play and purchase intention. Rauschnabel et al. (2017) also highlighted several gratifications for playing AR Pokémon games, such as nostalgia, enjoyment, physical activity, flow, and image improvement. Hence, there exists a research gap in identifying the visitors' needs for using multi-sensory VR and emerging gratifications based on those needs.

> **Research Objective 1:** To identify the visitors' needs for using multi-sensory VR and emerging gratifications based on those needs

In order to address the first objective, a total of 11 face to face interviews were conducted from the visitors visiting the VRlab of Deutsches Museum, Munich (Germany). VRlab provides a free of cost multi-sensory VR experience to visitors. The interviewees were asked about their motivations for using VR, and their responses were transcribed afterwards. The data were analysed from a theoretical point of view by using NVivo 12.

The different abstract ideas were characterised as the main construct. For example, words such as entertaining and fun represent a construct *entertainment*. Other words like education, learning, and getting information denoted the construct *education*. The profiles of the interviewees are given in Table 4.2. In order to protect interviewees' identity, names represent pseudonyms, and the age is categorised in decades. The results were then discussed with four experts (Professors of digital marketing, a practitioner, and a new media scholar) to get their insights on the emerging themes. Figure 4.4 shows the detailed emerging themes from interviews.

The visitors mentioned several needs for using multi-sensory VR discussed in section 4.4. Most prominently, entertainment, education, novelty, telepresence, reuse intention, and purchase intention. These variables are also studied in the literature with VR and tourism, for example, entertainment through VR experience leads to user satisfaction (Jung et al., 2018), entertainment creates the offline museum visit intention (H. Lee et al., 2020), and entertaining VR experience creates an intention to revisit the museum (Jung et al., 2016). These constructs were used to conduct further research based on the literature (Furst et al., 1996; S. Hudson et al., 2019).

6.2.2 Research objective 2

The existing literature overwhelmingly discusses the positive experience formed by collecting data at one time without exploring the needs of a tourist. On the contrary, researchers believe that real experience from technology can be studied by identifying the tourists' underlying needs for using technology, emerging expectations based on those needs (Rauschnabel, 2018b), and fulfilling expectations after using that technology (Palmgreen & Rayburn, 1979, 1985). Several scholars also professed the method of studying pre and post media usage as a suitable way to measure attitudinal change, beliefs,

satisfaction, behavioural intention, and behaviour (Bae, 2018; Bhattacherjee & Premkumar, 2004; Rokito et al., 2019).

Uses and gratifications theory, for the first time, made a distinction between gratifications sought and gratifications obtained. GS mainly deals with a person's desire to use a technological medium or refers to gratifications that individuals expect to obtain from a medium before they have come into contact with it. It is also known as motives in the literature. GO is the outcome received by a person from media (Bae, 2018) or refers to gratifications that individuals actually experience through a particular medium (Palmgreen & Rayburn, 1979). Pedagogical research deals with the gratifications of using VR (M. J. Kim, Lee, & Preis, 2020) but does not explain about the fulfilment of those gratifications. Consequently, the second objective of this research is to analyse the discrepancies between GS and GO from multi-sensory VR.

> **Research Objective 2:** To analyse the discrepancies between gratifications sought and gratifications obtained from multi-sensory VR

The data were collected twice, before and after VR use (see Bhattacherjee & Premkumar, 2004). Two big brochures (English and German) were displayed at the entrance of the VRlab to brief the visitors about the purpose of research, objectives, and data collection process. According to the nature of this research, convenience sampling was adopted. The sampling frame included those visitors who were willing to participate in a study, and the questionnaire was only given to them that were more than 18 years of age. As it is also evident from the literature of convenience sampling that *"participants are selected based on availability and willingness to take part"* (Shantikumar, 2018).

A total of 227 samples were collected for the analysis. The analysis yielded that GO from education, novelty, and telepresence exceeded GS, resulting in over fulfilling GS (GO > GS). On the contrary, only GO from entertainment was less from GS entertainment, resulting in under fulfilment of GS (GO < GS). Interestingly, a large pool of studies conducted in the context of VR and tourism concluded that VR provides an entertaining experience (Jeng et al., 2016; Jung et al., 2016, 2018; H. Lee et al., 2020; Wu et al., 2019), but the results are different when compared with the obtained vs expected.

6.2.3 Research objective 3

Museums are facing numerous challenges such as increased visitor expectations (Hume & Mills, 2011), shrinking budgets (Shannon & Willis, 2010), increased costs (Lindqvist, 2012), competition (Komarac et al., 2017), higher transparency demands how the taxpayer's money is used (Marstine, 2013), and audience that request sophisticated and digitised exhibits (Fan et al., 2008). Therefore, it is not surprising that museum managers are interested in adopting various digital technologies, ranging from websites (R. J. Wilson, 2011), social media (Kelly, 2013), ticketing systems (Cuseum, 2020), QR codes (Patil et al., 2018) to interactive screens (Citizen, 2014). Over the last years, museums also recognised XR's potential, particularly in AR and VR, as discussed in a recent survey among museum professionals (Shehade & Stylianou-Lambert, 2020). While related research indicates VR potential for museums, the academic literature lacks specific insights and evidence. Wojciechowski et al. (2004) provide guidance on how to realise XR projects, and others discuss the idea of creating virtual versions (i.e. substitutes) for real museums (Zouboula et al., 2008). Other studies have shown that VR, as a promotional tool, can motivate people to physically visit a real museum (H. Lee et al., 2020). There is a general assumption that VR can provide vivid and inspiring content (Willems et al., 2019)

and allow users to see and experience, thus, be a part of specific content. Indeed, pedagogical research has shown that, in controlled environments, VR can support learning quite effectively (Au & Lee, 2017; Halvorson et al., 2011; K.-T. Huang et al., 2019; Lau & Lee, 2015; Yobelli et al., 2018), yet research in this domain is still in its early stage. One of the core ideas is that well developed VR content can motivate students and thus, allow them to deeply immerse in the topic (Lau & Lee, 2015). However, in a museum context, users are not in a specific learning context, process several short experiences about different topics (with basic baseline interest), and might not just use it exclusively for learning purposes. Hence, the third objective is to study the impact of VR in providing education along with entertainment. As recommended by Loureiro et al. (2020), to research virtual experience in which a person can travel to another period of time to get an education along with entertainment, especially in the context of tourism.

Research Objective 3: To assess the effectiveness of multi-sensory VR in promoting education during tourism activities

Table 5.3 highlights the change in familiarity after using VR. The current study provided initial evidence that multi-sensory VR can be an effective tool for museums to educate the public – while also providing a form of entertainment to them. For all four contents, the researcher identified self-reported learning improvements. Interestingly, there was a drastic change in pre and post usage familiarities. It explained an essential phenomenon that the respondents preferred to get education from VR, and it is a good tool to provide education during tourism activities.

These findings also suggest that particular topics that might be perceived as "too exciting", such as the steam engine, could benefit particularly from VR. This study also

concludes that the mix of topics – as realised by Deutsches Museum – might be an effective way to attract visitors (e.g. with exciting topics such as the Apollo Mission) and surprise them with topics that many visitors might not perceive as too interesting at all.

6.2.4 Research objective 4

In academic literature, the gratification discrepancies approach has rarely been studied (Bae, 2018), a research objective two. Palmgreen and Rayburn (1985) tried to fill this void by studying six different models and two transactional models to measure satisfaction through hierarchical regression analysis. The present literature lacks the comparison of different models through robust statistical analysis dealing with the user's personal importance, GS, and GO. Therefore, due to scant research to understand and uncover the best suitable model to study gratifications, this research compares different models by using strong statistical analysis, i.e., SEM. Only those models are used in this research that Palmgreen and Rayburn (1985) recommended to study further. For instance, gratifications obtained model ∑(GO), simplified discrepancy model ∑(GO - GS), and transactional model ∑(GS+GO). Four other models were also studied that were overlooked in the literature, such as the gratifications sought model ∑(GS), discrepancy model weighted by users' personal importance ∑ j(GO - GS), modified gratifications obtained model ∑ j(GO), and transactional model ∑ j(GS+GO).

> **Research Objective 4:** To determine the best model among various models in measuring the consequences of media consumption

All of these models lead to similar conclusions that entertainment, enjoyment, and telepresence drive pleasant experience, whereas a negative and less relevant effect was noticed for novelty. However, it is found that the personal importance and gratifications sought might not matter too much in forming a pleasant experience. More specifically, when incorporating them into the models, the explained variance of the dependent variable decreased compared to simpler models (see Table 5.17). This result showed that experiences could "crash" existing expectations. In other words, visitors tend to evaluate the VR experience predominantly based on post usage evaluations. These post usage evaluations might include expectations (Cronin & Taylor, 1994), and expectations might change during the use. For instance, a visitor might intend to use a VR exhibit because they expect some form of entertainment, but they realise during the use that this specific exhibit is not as entertaining as expected. Still, this is important because they learned something really interesting. Thus, these initial expectations might have been washed out during the use and changed.

The findings also showed an unexpected effect of novelty, indicating that it tends to be negatively related. The new VR users might be overstrained with the device and its usability. Therefore, they cannot pay too much attention because of distractions. This aligns with the findings of Hinsch et al. (2020), who showed that a "wow-effect" in AR does not drive behavioural intentions. Based on a comparison of the models, the current study concludes that the gratifications obtained model has yielded the best R^2 values (see table 5.17) and the lowest error terms of asymptotical efficiency and consistency (see table 5.18). For the purpose of measuring how visitors rate VR experiences, a post-usage survey focusing on gratifications obtained is sufficient. Pre-Post-Comparisons do not produce good results, yet they are much more complex to perform.

6.2.5 Research objective 5

The existing literature on VR and tourism discusses the importance of continuance intention (H. Yang & Han, 2020), continued use intention (M. J. Kim & Hall, 2019), and behavioural intention to use VR in tourism (Tussyadiah et al., 2018; Vishwakarma et al., 2020a, 2020b). However, researchers overlooked studying reuse intention and purchase intention, as it is also evident from interviews that visitors have behavioural intentions for VR: reuse and purchase intentions. This research operationalised the reuse intention as a construct to study the visitors' intention to use multi-sensory VR at tourism destinations. The literature also empirically proves that reuse intention plays a vital role in predicting consumer behaviour (H. B. Kim et al., 2009; So & Kim, 2013). Moreover, other scholars overwhelmingly investigated the role of VR for visiting a specific destination that is shown in VR content (Adachi et al., 2020; An et al., 2021; Bogicevic et al., 2021; Flavián et al., 2019; Y. C. Huang et al., 2012, 2013, 2016; Itani & Hollebeek, 2021; Jung et al., 2016; M. J. Kim, Lee, & Jung, 2020; M. J. Kim, Lee, & Preis, 2020; H. Lee et al., 2020; T. Li & Chen, 2019; Marasco et al., 2018; Pasanen et al., 2019; Tussyadiah et al., 2018; Wagler & Hanus, 2018; Yuce et al., 2020; Yung et al., 2021). It leaves a research gap in studying the visitors' overall behavioural intention to use multi-sensory VR at other tourism destinations.

Purchase intention is operationalised as the willingness of a visitor to purchase VR for personal usage. This construct is also considered because of the visitors' motivations for using VR (discussed in sub-section 4.4). Several researchers studied purchase intention in the context of VR and tourism. For example, Jeng et al. (2016) investigated the purchase intention of a product, Lo and Cheng (2020) explored the purchase intention after experiencing the VR of a hotel advertisement, Wen and Leung (2021) studied the purchase

intention for wine, and Willems et al. (2019) investigated the tour purchase intention. Again, researchers overlooked the study of purchase intention of VR because it is also evident from the literature that users want to purchase a technology after using it (S.-H. Kim, 2010). In analysis 2 (see section 5.8), reuse and purchase intentions were used as dependent variables. GO constructs were used as independent variables for analysis 2 because of the best R^2 values (see table 5.17) and lowest error terms of asymptotical efficiency and consistency (see table 5.18).

The phenomenon of pleasantness of experience has a long-standing in business literature (Kaltcheva & Weitz, 2006). Van Kerrebroeck et al. (2017a) found that pleasant experience leads to consumer responses such as attitude toward the mall, approach/avoidance behaviour, higher mall satisfaction, and higher loyalty intentions. Kaltcheva and Weitz (2006) concluded that pleasantness of experience plays a mediating role in predicting the individual's behaviour. However, the extant research has yet to explore the mediating role of constructs in the context of new technologies such as VR (Shahab et al., 2021). The same is mentioned by Loureiro et al. (2019) after conducting a literature review of 150 research documents published in the context of virtual reality and marketing: *"previous studies tend to regard constructs such as pleasure, arousal, vividness and telepresence as mediators between stimuli and behavioural intentions. However, we suggest other mediators…"* (p. 12). Therefore, this research is the first to model pleasantness of experience as a mediator between gratifications obtained and behavioural intentions.

> **Research Objective 5:** To examine the mediating role of pleasantness of experience between gratifications obtained and behavioural intentions

It is found that entertainment, education and telepresence positively influence the pleasantness of experience; only novelty showed insignificant influence. Entertainment gratification is the predictor of pleasantness of experience, which is aligned with the literature (Jung et al., 2016, 2018; H. Lee et al., 2020; Menon & Kahn, 2002; tom Dieck et al., 2018). It can be explained with the help of the phenomenon of the carry-over effect, which describes the arousal or pleasure from a prior experience that continues to a succeeding experience (Menon & Kahn, 2002). In this research, entertaining experience from multi-sensory VR leads to pleasantness of experience. Interestingly, entertainment gratification is the weakest predictor of pleasantness of experience among other gratifications such as education (strongest) and telepresence (second strongest). The main reason for this weak prediction can be the content of VR that is more related to education.

Education gratification is the strongest predictor of pleasantness of experience, which is also evident from the effectiveness of VR in educating visitors. The current study provides initial evidence that VR can be an effective tool for museums to educate the public – while also providing a form of entertainment to them. For all four contents, this research identified self-reported learning improvements. The findings also suggest that particular topics that – at least at first – might be perceived as "too exciting", such as the steam engine, could benefit particularly from VR. This research also concludes that the mix of topics, as realised by Deutsches Museum, might be an effective way to attract consumers (e.g. with exciting topics such as the Apollo Mission) and surprise them with topics that many visitors might not perceive as too interesting at all.

It is found that novelty is not a predictor of pleasantness of experience. Novelty had a detrimental effect, contrary to expectations. Inexperienced VR users may have trouble

using multi-sensory VR. Distractions prevent them from focusing. It coincides with Hinsch et al. (2020), who found that AR "wow-effect" does not promote behavioural intentions.

The findings provide initial evidence that multi-sensory VR, if well designed, can be an effective tool for museums. It is found that a combination of entertaining and educating content that gives visitors the feeling of actually being part of a virtual world (telepresence) is promising. The research concludes that well-developed (e.g., design, colours, 3D effects, sound, etc.) content displayed through appropriate devices (e.g., resolution, field of view, degrees of freedom, etc.) typically leads to a higher level of telepresence. Consequently, telepresence is a second strong predictor of pleasantness of experience.

As mentioned earlier, this research uses mediation analysis according to the guidelines provided by Zhao et al. (2010). Zhao and colleagues suggested four options for mediation vs non-mediation (see section 5.8.1.2). The same typology of mediations and non-mediations is also mentioned below (Zhao et al., 2010, p. 204):

i. *If a x b is significant but c is not, you have indirect-only mediation.*
ii. *If a x b is not significant but c is, you have direct-only non-mediation.*
iii. *If neither a x b nor c is significant, you have no effect non-mediation.*
iv. *If both a x b and c are significant, determine the sign of a x b x c by multiplying the three coefficients, or by multiplying c by the mean value of a x b from the bootstrap output. If a x b x c is positive, it is complementary mediation; if a x b x c is negative, it is competitive mediation.*

It is found that pleasantness of experience has a complementary mediating role between all gratifications obtained (education, entertainment, telepresence) and

behavioural intentions (reuse and purchase) except novelty (see table 5.24). Overall, this complementary mediation phenomenon concludes that pleasant experience motivates visitors to reuse multi-sensory VR and purchase it for personal uses.

The visitors reported that they are interested in purchasing VR for their personal use. It addresses the major concern of VR that it is not meeting the selling targets and it is not reaching the target audience money-wise. VR has a strong potential and it will get a good market value very soon. As Facebook has also changed its name to Meta Platforms, Inc. and other companies including HTC, Sony, and Google are also investing in VR. There will be a huge competition in the market and organisations with practical implications of VR will get a competitive advantage over others.

The results summary of all research questions and objectives are given in table 6.1.

6.3 Hypotheses test results

Table 6.2 provides a list of construct relationships, path coefficients, p-values, and support/rejection of the hypothesis. A total of eight hypotheses were proposed in section 3.3. H1 to H4 and H8 simply refer to a single relationship. Contrary, H5 is twofold, and mediation related hypotheses (H6 & H7) are fourfold. All hypotheses are supported, except those that are related to novelty, for instance, H3, H6c, and H7c.

Education is a strong predictor of pleasantness of experience (having a path coefficient of 0.288 with 0.1% confidence level), followed by telepresence (path coefficient of 0.279 with 0.1% confidence level) and entertainment (path coefficient of 0.216 with 0.5% confidence level). Pleasantness of experience strongly influences the reuse intention (path coefficient of 0.490 with 0.1% confidence level) as compared to the purchase intention (path coefficient of 0.276 with 0.1% confidence level). However, reuse

intention also influences purchase intention (path coefficient of 0.360 with 0.1% confidence level).

Pleasantness of experience plays a mediating role between all gratifications obtained and behavioural intentions, except novelty. The strongest mediating role is between education and reuse intention (path coefficient of 0.141 with 0.1% confidence level).

6.3.1 GO Entertainment → Pleasantness of experience

The result supports H1, which postulates that entertainment positively influences pleasantness of experience. This result aligned with the literature, where entertainment creates a positive visitor experience that further influences intention to revisit the museum (Jung et al., 2016), entertaining experience forms the overall positive VR museum experience (H. Lee et al., 2020), entertainment leads to user's satisfaction and willingness to pay extra for VR experience (Jung et al., 2018), and entertainment determines visitors' overall evaluation of the on-site AR experience (tom Dieck et al., 2018).

6.3.2 GO Education → Pleasantness of experience

The result also supports that entertainment positively influences pleasantness of experience, hence supporting H2. It is in line with the concept that users prefer to use media to get important, helpful, and useful information (Athwal et al., 2019; Basak & Calisir, 2015). It is also evident from the literature that: when education is provided to the visitors at a tourism destination through VR, it leads to a positive visitor experience (Jung et al., 2016) and an overall positive VR museum experience (H. Lee et al., 2020).

6.3.3 GO Novelty → Pleasantness of experience

The hypothesis (H3) postulating that novelty influences pleasantness of experience is not supported, hence rejecting H3. One of the reasons could be that 61.7% of the

respondents did not experience VR before or are familiar with VR. Multi-sensory VR at Deutsches Museum is 6DoF, the latest and most complex technology. Visitors' unfamiliarity with VR and complex technology may be responsible for not having a positive influence on pleasantness of experience.

6.3.4 GO Telepresence → Pleasantness of experience

The result supports that telepresence positively influences pleasantness of experience, hence supporting H4. This concurs with the notion that telepresence leads to a flow experience (D. Kim & Ko, 2019), and a sense of presence influences the tourism brand experience (Bogicevic et al., 2019). Deutsches Museum visitors also like telepresence through multi-sensory VR, which makes it a pleasant experience.

6.3.5 Pleasantness of experience → Behavioural Intentions

The result also supports H5, which postulates that the pleasantness of experience positively influences reuse and purchase intention. It is also in line with the literature that positive experiences lead to positive behavioural intentions (Jung et al., 2016; Nasermoadeli et al., 2013; So & Kim, 2013).

6.3.6 GO → PLExp → Behavioural Intentions

The result shows that pleasantness of experience plays a mediating role between entertainment and reuse intention (supporting H6a), education and reuse intention (supporting H6b), telepresence and reuse intention (supporting H6d). Interestingly, no mediation was found between novelty and reuse intention, hence, rejecting H6c.

Pleasantness of experience showed the same mediating results with purchase intention. Entertainment and purchase intention were mediated by pleasantness of experience (supporting H7a), education and purchase intention (supporting H7b),

telepresence and purchase intention (supporting H6d). While no mediation was found between novelty and purchase intention, hence rejecting H6c.

The complementary mediating phenomenon of pleasantness of experience overall concludes that visitors got the motivation to reuse multi-sensory VR and also to purchase it. These results align with the literature where pleasantness mediates the relationship between arousal and shopping behaviour (Kaltcheva & Weitz, 2006), aesthetic stimulation from the physical environment, and behavioural intentions (Horng & Hsu, 2021). Recently, Angelino et al. (2021) studied the role of VR on students' engagement. Angelino and colleagues investigated the mediating role of pleasantness of experience between telepresence and memory and between telepresence and students' engagement. They found that pleasantness of experience does not have a mediating role in both cases. Contrary, in this research, pleasantness of experience has a mediating role between telepresence and behavioural intentions. It can be concluded that multi-sensory VR has a higher feeling of telepresence as compared to simple VR (Rauschnabel et al., 2022). Hence, a positive mediation effect is found between telepresence and behavioural intentions.

6.3.7 Reuse Intention → Purchase Intention

The result also supports H8, which posits that reuse intention positively influences purchase intention. It is also evident from the literature that technology users who get a positive experience from the technology usually want to reuse the technology or purchase it (H. B. Kim et al., 2009; S.-H. Kim, 2010), and behavioural intentions also influence each other (Y.-T. Chang et al., 2015).

Table 6.1 Summary of research questions, objectives and results

No.	Research questions	Research objectives	Results
1	What are the visitors' needs for using multi-sensory VR experiences in museums?	To identify the visitors' needs for using multi-sensory VR and emerging gratifications based on those needs	A total of 11 face to face interviews were conducted from the visitors visiting the VRlab of Deutsches Museum, Munich (Germany). They mentioned several needs for using multi-sensory VR, for instance, entertainment, education, novelty, telepresence, reuse intention and purchase intention
2	What is the role of gratifications sought and gratifications obtained in providing pleasantness of experience?	To analyse the discrepancies between gratifications sought and gratifications obtained from multi-sensory VR	The analysis yielded that GO from education, novelty and telepresence exceeded GS, resulting in over fulfilling GS (GO > GS). On the contrary, only GO from entertainment was less from GS entertainment, resulting in under fulfilment of GS (GO < GS)
3	What is the effectiveness of multi-sensory VR in promoting education during tourism activities?	To assess the effectiveness of multi-sensory VR in promoting education during tourism activities	Multi-sensory VR is an effective tool for museums to educate the public – while also providing an entertainment to them. For all of the four contents, visitors reported learning improvements because of a drastic change in pre and post usage familiarities
4	What is the best suitable model to measure the consequences of media consumption?	To determine the best model among various models in measuring the consequences of media consumption	A simple approach to study gratifications obtained is the most effective way to measure the consequences of media consumption
5	Does pleasantness of experience mediate the relationship between gratifications obtained and behavioural intentions?	To examine the mediating role of pleasantness of experience between gratifications obtained and behavioural intentions	Pleasantness of experience plays a complementary mediating role between gratifications obtained (education, entertainment, telepresence) and behavioural intentions (reuse and purchase) except novelty

Table 6.2: Structural model results of analysis 2

Construct Relationship	Path coefficient	Support for hypothesis
Main Model		
GO Entertainment → Pleasantness of experience	0.216**	Yes (H1)
GO Education → Pleasantness of experience	0.288***	Yes (H2)
GO Novelty → Pleasantness of experience	-0.096(ns)	No (H3)
GO Telepresence → Pleasantness of experience	0.279***	Yes (H4)
Pleasantness of experience → Reuse Intention	0.490***	Yes (H5a)
Pleasantness of experience → Purchase Intention	0.276***	Yes (H5b)
Reuse Intention → Purchase Intention	0.360***	Yes (H8)
Mediation-Pleasantness of experience		
GO Ent → PLExp → Reuse Intention	0.106**	Yes (H6a)
GO Edu → PLExp → Reuse Intention	0.141***	Yes (H6b)
GO Nov → PLExp → Reuse Intention	-0.047(ns)	No (H6c)
GO TP → PLExp → Reuse Intention	0.137**	Yes (H6d)
GO Ent → PLExp → Purchase Intention	0.059*	Yes (H7a)
GO Edu → PLExp → Purchase Intention	0.079**	Yes (H7b)
GO Nov → PLExp → Purchase Intention	-0.026(ns)	No (H7c)
GO TP → PLExp → Purchase Intention	0.077**	Yes (H7d)

Note: *** = significant at the 0.1% level; ** = significant at the 0.5% level; * = significant at the 5% level

CHAPTER 7: CONCLUSION

7.1 Introduction

The previous chapter discusses the results. This chapter with the help of three sections, concludes the whole research by explaining the (a) theoretical contributions, (b) contributions to the management of VR, (c) limitations and future research agenda.

7.2 Theoretical contributions

As discussed above, museums (and many other cultural institutions) are trying to find ways to integrate innovative experiences into their – often traditional and/or historical – exhibits. Scholars and museum managers alike, as well as policy makers, who typically finance museums through taxpayer money, may have a particular interest in understanding if and how VR can contribute to the goals of museums, such as providing pleasant museum experiences and ultimately educating societies. Interviews and a quantitative main study provide answers to the existing research gaps.

The main results are that multi-sensory VR experience is effective in promoting learning among visitors. This research also identified several differences between obtained and sought experiences, as well as their interplay in forming assessments. While these findings support the potential of VR in a museum context, the study also generates multiple theoretical contributions and implications for museum managers.

This research found that entertainment, education, and telepresence are the driving factors behind pleasant experience with multi-sensory VR. After comparing several ways in the literature which can be used to measure gratifications, it is found that gratifications obtained should be used in future for effective research. Also, VR showed improvements in enhancing visitor knowledge in an informal environment. These findings make five major contributions to the literature, which are discussed below.

The first contribution is to the literature on VR in a museum context. As discussed above, little research has been conducted on visitor behaviour in VR. This research is based on the results of a pre-study and identified four constructs: entertainment, telepresence, novelty, and education. This research utilises some of the under looked nuanced gratifications proposed by Sundar and Limperos (2013) in the 2.0 version of U&G theory. These nuanced gratifications are novelty and telepresence because novelty and telepresence are not empirically studied with VR and U&G theory, respectively. All four constructs tend to matter in some way, in particular entertainment, telepresence, and education as driving factors behind the overall assessment of the experience. This study thus contributes to the literature on museum VR by uncovering specific motivations.

Second, VR literature has typically studied how users react to VR in terms of their expectations (Herz & Rauschnabel, 2019) and their assessments (M. J. Kim et al., 2020). However, to measure actual impacts, scholars from other research areas have suggested that expectations and assessments do not always match, but consumer reactions may still be positive. This gap is addressed by comparing expectations (GS) with experiences (GO). The results showed that the traditional U&G view is not false, but assessments on their own (GO) explain reactions better (as indicated by a higher *R-squared* value). This could mean that visitors intend to use the VR exhibit because of certain motives, yet change their mind during use and thus assess it based on other factors. In this case, consumers reported the importance of entertainment (M=5.34) and novelty (M=5.61), two variables that are highly correlated with the corresponding gratification sought. However, across the comparison models, these variables are less relevant for the overall experience than education – a variable with lower expected values (M=4.91) and lower importance (M=5.17).

Third, in literature conflicting theories are seen that how users form assessments in general, and prior U&G theory research has (often implicitly) followed the confirmation-disconfirmation paradigm, yet this assumption has rarely been studied (Bae, 2018). One would expect that a model using both expectation and post-usage assessments would lead to better results. This research contributes to the literature by suggesting a more careful use of this assumption. More specifically, this research compared different ways of conceptualising and modelling gratifications, and it turned out that a "simple" approach was most effective. Pre-Post-Comparisons can be an effective tool for measuring how users evaluate the exhibit before and after its use. By doing so, it can generate insights into expectations and experiences and learning improvements. However, if such a research design is too complex, it is recommended to only use post usage data collections.

The user's personal importance was also considered in this research. The theoretical contribution of considering individual differences in visitors' assessments lies in the recognition that not all visitors form their assessments in the same way. By acknowledging the varying interests and priorities of visitors, such as the examples given of an education-focused visitor and an entertainment-focused visitor, researchers and practitioners gain insight into the different factors that influence visitors' assessment and evaluation processes. This understanding allows for an appreciation that meeting expectations is of greater importance for visitors whose interests align closely with a specific aspect, such as entertainment in the case of the second visitor. Consequently, this theoretical perspective highlights the need for tailored approaches in designing and evaluating visitor experiences, taking into account the diverse motivations and expectations of different visitor segments. By recognizing and catering to these individual differences, researchers and practitioners can enhance the

effectiveness and satisfaction of visitor experiences in various domains, be it education, entertainment, or other specific interests.

It was also found that importance and expectation may not play a large role in the formation of assessments. More specifically, when incorporating them into the models, the explained variance of the dependent variable decreased compared to simpler models. The reason for this is discussed in the previous paragraph, namely that actual experiences can "crash" existing expectations, leading to a new assessment.

Altogether, this research concludes that:

- A post-usage survey focusing on gratifications obtained is sufficient for measuring how visitors rate VR experiences.

- Pre-usage measures are relevant if managers want to identify the reasons why visitors intend to use VR. In this case, the researcher recommends surveying random samples of visitors and not, as in this study, users already waiting in a queue. As the results showed, their expectations are strongly correlated with the extent to which the fulfilment of a specific gratification is important for a user.

Fourth, findings also showed an unexpected effect of novelty and indicated that it tends to be negatively related. Consumers new to VR may be overwhelmed by the device and its use and therefore cannot pay sufficient attention to VR because they are distracted. This aligns with findings from Hinsch et al. (2020), who show that a "wow-effect" in AR does not influence behavioural intentions. Likewise, the correlational analyses show that better experiences correlate with higher learning effectiveness (future research must determine the causality).

Fifth, study of the effectiveness of VR in educating visitors. The current study provides initial evidence that VR can be an effective tool for museums to educate the

public while also providing them with a form of entertainment. For all four contents, self-reported learning improvements are noticed. The findings also suggest that topics that may be perceived as less exciting, such as the steam engine, can in particular benefit from VR. This research concludes that the mix of topics, as realised by Deutsches Museum, may be an effective way to attract consumers (e.g. with exciting topics such as the Apollo Mission) but also to surprise them with topics that many visitors may not feel to be overly interesting.

Sixth, gratifications obtained are a crucial factor that helps in predicting the pleasantness of experience, reuse, and purchase intention. This study further strengthens the uses and gratifications theory by providing robust evidence of how the GO influences users' responses to multisensory VR. It helps understand visitors' reuse intention of VR at tourism places and purchase intention. It is also aligned with the literature that multi-sensory XR develops a positive destination-image (Santoso et al., 2022).

Seventh, pleasantness of experience plays a complementary mediating role between gratifications obtained (education, entertainment, telepresence) and behavioural intentions (reuse and purchase) except novelty. Overall, this complementary mediation phenomenon concludes that pleasant experience motivates visitors to reuse multi-sensory VR and purchase it for personal uses. The visitors reported that they are interested to purchase VR for their personal usage. It addresses the major concern of VR that it is not meeting the selling targets and it is not reaching the target audience money-wise. VR has a strong potential, it will get a good market value very soon, and this purchase intention will be sustained in the future. As Facebook has also changed its name to Meta Platforms, Inc. and other companies including HTC, Sony, and Google are also investing in VR. There is a huge

competition in the market and organisations with practical implications of VR will get a competitive advantage over others.

In short, this research addresses several research gaps existing in the literature along with those identified by other researchers. From a theoretical perspective, this research deals with the gratifications sought and gratifications obtained in the context of virtual reality and tourism. This research has several theoretical contributions: first, it identifies the visitors' needs and gratifications for using multi-sensory VR. Second, it studies the change in fulfilment of gratifications and familiarities (with Sulzer steam engine, automobile, glider, and landing on the moon) through pre and post usage experience. This study showed that multi-sensory VR provides education and an entertaining experience at tourism destination. Third, it compares different models used in the literature to study gratifications. It extends previous literature by directing academic attention towards the best model that should be further used in U&G research. Fourth and fifth, it takes gratifications that the researchers under-look. The current study proposes and tests three gratifications that are not empirically explored with U&G theory. It is also evident from previous research that studying nuanced gratifications causes a strong contribution to the literature (see Barton, 2013). Sixth, GO constructs predicted the pleasantness of experience, reuse, and purchase intentions. Seventh, pleasantness of experience played a mediating role between reuse and purchase intentions.

7.3 Implications for the management of VR

Most of the DMOs are using VR for entertainment purposes, but from this research, it is evident that visitors are getting a more positive experience through educational content, which helps create reuse and purchase intention. Hence, education through VR is also essential. The findings provide initial evidence that VR, if well designed, can be an effective tool for museums. It is found that a combination of

entertaining and educating content that gives visitors the feeling of actually being part of a virtual world (telepresence) is promising. The research concludes that well-developed (e.g., design, colours, 3D effects, sound, etc.) content displayed through appropriate devices (e.g., resolution, field of view, degrees of freedom, etc.) typically leads to a higher level of telepresence. However, factors that increase education and entertainment might strongly depend on the topic and target group.

Besides entertainment and education, visitors also demand new and unique VR content. Visitors support new VR content introduced by businesses, for instance, a French business-Fly View launched a VR- jetpack aerial view of Paris, four seasons resort in USA provides VR experience of deep oceans, deep space, and deep caves and Japanese business-First Airlines introduced VR flying experience of different destinations. Marketers are also using it for promotion. Like USA-based marketing firm launched the travel world VR application, potential tourists can experience the tour operators, hotels, resorts, destination, and cruise lines. Australian-based business Qantas also provides the same VR experience to help users for deciding to visit a destination (Chandler, 2020). Moreover, the complementary mediation suggests that marketers and managers should aim to enhance visitors' pleasant experiences because it leads to VR reuse and purchases. Hence, their strategies for developing VR content should include introducing new content that offers a high degree of telepresence while having a balanced blend of education and entertainment (adding a touch of humour would be more beneficial).

7.4 Limitations and future research

This research represents a starting point for studying visitors' use of a multi-sensory VR exhibit in an actual museum. While the proposed research design has its strengths – such as a combination of interviews and quantitative data, and a real study context – it also has some limitations. Most importantly, this research studied one

exhibit with four different topics. The visitors expected more from VR in terms of entertainment, but it failed to provide an entertaining experience. One of the reasons can be the VR content shown in Deutsches Museum is more related to education. Hence, future studies should focus on factorial experiment research design to compare the impact of VR content with high/low entertainment and education. Moreover, convenience sampling is used in this research by collecting data from visitors who showed willingness to participate in the study. However, available participants may not represent the broader population accurately.

Next, given the scope of the study, the time lag between pre and post measures was relatively short, a factor that might have an impact on the results. Finally, self-reported measures on learning effectiveness might be relevant from a motivational perspective. Yet, future studies might apply multiple-choice tests (or other quantifiable tests) with a longer time lag. Such insights could strengthen the conclusions.

Another limitation is due to the nature of this research. It is not dealing with the other aspects of multi-sensory like taste and smell. Future research should also focus on VR content that provides an opportunity to use all five senses. Moreover, only four gratification discrepancies are used according to the VR content of Deutsches Museum, whereas there is a need to study gratifications that are related to other tourism fields.

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