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Virtual Reality Transforming the Digital Learning Environment: An Analysis of Students' Acceptance

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Abstract

Virtual reality (VR) is gaining prominence in post-secondary education. In fields such as medicine or engineering education, VR is widespread and enhances educational opportunities. The technologies' popularity is, however, swapping over to more theoretical fields of study. Institutions, therefore, need to understand what factors influence the decision of post-secondary students to accept immersive VR applications in non-practical lectures. The Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) provides a theoretical framework for technology acceptance research. While most previous studies have taken a quantitative approach, this study adopts a qualitative method to deliver profound insights into the students' perspectives on VR acceptance. Based on a thematic analysis of focus group interviews, the study extends UTAUT2 by adding two core constructs and additionally identifying upstream factors influencing all core constructs of UTAUT2. The results indicate that the original UTAUT2 is too superficial to capture the underlying influences on students' VR acceptance. Thereby, my study contributes to current VR acceptance research by providing a context-specific UTAUT2 model that may guide decision-makers in successfully implementing VR in post-secondary education.

Keywords: Virtual reality; Technology acceptance; UTAUT2; Post-secondary education.

1. Introduction

Virtual reality (VR) is not as futuristic as often portrayed. Especially in fields such as engineering or medicine, the technology is already widely used (Jayaram et al., 2007, p. 217; Burdea & Coiffet, 2003, p. 3). Technological advancements and cost reductions made VR applications more accessible than ever (Concannon, Esmail, & Roduta Roberts, 2019, p. 2). Specifically, immersive VR technologies using head-mounted displays (HMD) have gained popularity, and the amount of available content has increased (Statista, 2021, p. 4). New HMDs such as the Oculus Quest 2 offer an excellent price-performance ratio, making VR increasingly attractive for universities (Radianti, Majchrzak, Fromm, & Wohlgenannt, 2020, p. 2).

After almost three years of online education, the question if VR could be a game-changer for the educational sector has arisen. Due to the Covid-19 pandemic, face-to-face teaching has been shifted to online formats. This situation impacted students' educational experience and diminished the quality of education. Undergraduate students reported decreased motivation, isolation, and communication difficulties (Baltà-Salvador, Olmedo-Torre, Peña, & Renta-Davids, 2021, p. 18-19; Almossa, 2021, p. 7173-7177). A study carried out during the pandemic observed an increased interest in introducing immersive VR in education (Radianti et al., 2020, p. 22).

Amplified theoretical research on VRs' educational application additionally indicates its rising recognition (Radianti et al., 2020, p. 22; Abich, Parker, Murphy, & Eudy, 2021, p. 923). The global VR market is expected to be valued at USD 12.19 billion by 2024 growing significantly from USD 3.89 billion in 2020. Experts predicted technology disruptions in the educational sector and forecasted VR to be used for immersive classroom experiences and soft-skill training (Statista, 2021, p. 5-20). Due to the increasing potential of VR technology and the significant cost reductions, it is time to study immersive VR in education further.

Literature on immersive VR in education particularly debated its effectiveness in teaching. Parong and Mayer (2018) have noticed higher motivation of students, however, worse learning success (p. 794). Contrary, Li, Liang, Quigley, Zhao,

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and Yu (2017) have demonstrated immersive VR training to be effective (p. 1283). The content-based learning approach of VR especially improves creative and problem-solving skills (Velev & Zlateva, 2017, p. 35). Another research field relating to VR in education addresses the acceptance of VR, describing what influences users' decision to accept VR as a teaching tool. Available acceptance research, however, mainly focuses on VR acceptance in other domains than education or considers other educational technologies (Toyoda, Abegao, Gill, & Glassey, 2021, p. 1; Bernd, 2001, p. 1-2). The existing body of literature, nevertheless, suggests similar factors influencing students' technology acceptance. The scarce research on VR acceptance in education tended to focus on quantitative methods generating broadly applicable findings rather than concentrating on the underlying students' perspective (Noble, Saville, & Foster, 2022, p. 7; Fussell & Truong, 2022, p. 255; Chahal & Rani, 2022, p. 9-10).

Even though the acceptance of VR applications has been discussed rather extensively, only a few studies in the literature focus on students' VR acceptance in theory education. Using primarily quantitative methods, the inherent factors influencing students' decisions remain unclear. In an attempt to fill this research gap, my study addresses the question: What factors influence the decision of post-secondary students to accept the use of immersive VR applications in a non-practical lecture? Using an exploratory qualitative approach, I conducted focus group interviews with three different groups of post-secondary students.

The thesis aims to find influencing factors on a students' decision to use immersive VR applications in a theoretical educational setting. The goal is to categorise the gathered qualitative data into distinct influencing themes. The heterogeneity of the focus groups allows for collecting deep and diverse insights into post-secondary students' decision-making (Saunders, Lewis, & Thornhill, 2019, p. 321-322). I based the research on the extended Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), which describes factors influencing consumers to accept and use technology (Venkatesh, Thong, & Xu, 2012, p. 158-159). The theory is appropriate as post-secondary students can be considered customers of universities (Guilbault, 2016, p. 137). Part of the aim is to develop an extension of the UTAUT2 model, specifically applicable to students' VR acceptance in post-secondary education.

The findings of the exploratory study contribute to the existing literature on VR acceptance and generate a deeper understanding of post-secondary students' intention to use VR. By providing a proposed extension of UTAUT2, I reveal underlying linkages of acceptance factors as a conceptual model. From a managerial perspective, the research primarily informs universities implementing VR and supports them in ensuring students' acceptance. In addition, companies can use the results to understand their customers' acceptance of VR client training and thus increase the likelihood of adoption.

The thesis is structured into four parts. The following section introduces the theoretical background examining the existing literature on VR aspects, primarily focusing on its application in education. The subsequent section illustrates the research design, data collection, and analysis approach. The results are then presented and immediately discussed along with the identified core themes, and the part ends with the extended model of UTAUT2. The final section discusses how these findings contribute to the existing literature and outlines managerial implications, limitations, and opportunities for future research.

2. Theoretical background

The first patent for VR was issued in 1962, and the initial idea significantly developed in 1965 (Burdea & Coiffet, 2003, p. 3-4; Sutherland, 1965, p. 506-507). Hence, VR is not a recent innovation. The big buzz around VR, however, resurfaced in 2021 when Meta launched and heavily marketed its metaverse, claiming it could be the new internet where people not only play games but also collaborate and enjoy their free time. (BBC, 2021, para. 1-3). The technology, in general, can be defined as "a way of transporting a person to a reality . . . , in which he or she is not physically present but feels like he or she is there" (Rebelo, Noriega, Duarte, & Soares, 2012, p. 969). Zhang (2014) further defines VR as "a kind of special environment generated by a computer . . . people can dominate or control . . . " (p. 2427).

There is a distinction between non-immersive and immersive VR applications (Ventura, Brivio, Riva, & Baños, 2019, p. 2). In my thesis, I focus on immersive VR, which has proven to be more effective in education and leads to better performance of mental activity (Bailey, Johnson, Schroeder, & Marraffino, 2017, p. 9; Ragan, Sowndararajan, Kopper, & Bowman, 2010, p. 541). In recent years, interest in adopting VR in education has increased, and the application of immersive VR has been intensively researched (Radianti et al., 2020, p. 22; Concannon et al., 2019, p. 1-2). One reason for this development could be the amplified availability and accessibility of consumer HMDs (Concannon et al., 2019, p. 2; Battussi & Chittaro, 2017, p. 1063). Additionally, recently developed HMDs offer an excellent price-performance ratio, making VR increasingly attractive for universities (Radianti et al., 2020, p. 2).

2.1. Virtual reality technology

VR delivers solutions in various fields, including engineering, medicine, and the military (Burdea & Coiffet, 2003, p. 3). Recent research on VR has ranged from survival training for kids to applications for mental health (Molan, Weber, & Kor, 2022, p. 1; Bell, Nicholas, Alvarez-Jimenez, & Thompson, 2020, p. 169). One of the main advantages of VR is its flexibility, which enables virtual content to illustrate a variety of cases (Bliss, Tidwell, & Guest, 1997, p. 84). Likewise, related technologies such as augmented reality (AR) have found increasing popularity in the same domains of application (Alkhamisi & Monowar, 2013, p. 28). AR, however, belongs to the mixed realities and displays real and virtual objects at the same time (Milgram & Kishino, 1994, p. 1323-1326). Apart from the specific application or the technology in use, different features shape the virtual experience.

2.1.1. VR features

Terms describing features of VR do not have a homogeneously used meaning across literature and, therefore, need to be defined to ensure consistent terminology (Radianti et al., 2020, p. 22). According to Burdea and Coiffet (2003), VR consists of the three Is', including immersion, interaction, and imagination (p. 3). The term *immersion* describes the feeling of being inside a virtual environment (VE), and the sense of hearing and sight are most crucial for its creation (Rebelo et al., 2012, p. 969). *Interactivity* is created with multiple sensory channels and is increased by input hardware such as motion trackers or sensing gloves (Rebelo et al., 2012, p. 970). The term *imagination* implies the ability of the brain to perceive fictional things (Burdea & Coiffet, 2003, p. 3). These three features are the most vital for a satisfying VR experience. However, additional terms have been applied in the literature.

Closely related to *immersion* and *interactivity* is *fidelity*. This term implies the perceived degree of realism of the experienced VE (Ragan et al., 2015, p. 794). Witmer and Singer (1998) define the feature of *involvement* as "a psychological state experienced as a consequence of focusing one's ... attention on a coherent set of stimuli ..." (p. 227). Lastly, *presence* refers to shifting the attention from a physical to a virtual setting. *Presence* is the combination of *involvement* and *immersion and* increasing both features leads to a superior level of *presence* (Witmer & Singer, 1998, p. 226-227). Understanding the different terms will help when interpreting the results later.

2.1.2. Immersive VR

As I will focus on immersive VR applications, it is necessary to clarify the concept of immersion further. Research has found that immersive VR compared to non-immersive applications, can lead to improved skill and knowledge acquisition, higher engagement and enjoyment (Concannon et al., 2019, p. 14-15). People experiencing immersion describe themselves to be "in" the VE. However, despite this unique engagement, immersion can cause a lack of awareness in time (Jennett et al., 2008, p. 643-657).

Different levels of immersion are caused by various factors such as VE construction or real-world distractions (Jennett et al., 2008, p. 642). The level of immersion increases with more realistic VEs, bundled user concentration and the representation through a virtual body, known as an avatar (Liang et al., 2017, p. 11; Rebelo et al., 2012, p. 971; Slater & Wilbur, 1997, p. 606). To support the creation of immersion, immersive VR utilises devices such as HMDs or cave automatic virtual environments (Cochrane, 2016, p. 46; Liang et al., 2017, p. 11). HMDs convey visual, audio, or tactile cues creating a more realistic environment and enabling more intuitive virtual interaction (Bailey et al., 2017, p. 2; Liang et al., 2017, p. 1). Since immersive VR causes improved concentration and performance, its usage in education could be beneficial.

2.2. VR in education

VR was already studied in several educational fields, such as medical training, safety education, engineering, or assembly task training (Huang, Liaw, & Lai, 2016, p. 3; Li et al., 2017, p. 1275; Wang, Wu, Wang, Chi, & Wang, 2018, p. 1; Jayaram et al., 2007, p. 217). Hence, its use in education is not new Cochrane, 2016, p. 46. Recent research primarily focused on medical-related topics and VR usage in higher education. However, there is a rising popularity of VR education across industries (Abich et al., 2021, p. 932; Kavanagh, Luxton-Reilly, Wuensche, & Plimmer, 2017, p. 89). This increase in attractiveness could be explained by more content availability, cost reduction of equipment and government interest (Abich et al., 2021, p. 923).

Universities mainly implement VR because of skills training, increased engagement, convenience, and team building (Concannon et al., 2019, p. 14-15). VR enables the direct practice of new tasks by avoiding the gap between theory and practice (Li et al., 2017, p. 1283). For example, the technology allows users to flexibly enter any location at any condition without being at risk (Rebelo et al., 2012, p. 970). Alternatively, users can simulate complex tasks or situations to study critical skills (Freina & Ott, 2015, p. 4; Bailey et al., 2017, p. 2). VR saves time and money and enables accessible and early-stage data collection during the design or training phase (Rebelo et al., 2012, p. 970; Carlson, Peters, Gilbert, Vance, & Luse, 2015, p. 780). The technology, likewise, is an opportunity for disabled people who are less satisfied with the current learning environment (Freina & Ott, 2015, p. 6; Gierdowski, 2019, p. 20). By introducing VR, the existing teacher-centred approach might shift to more student-centred learning and promote the education of 21st-century skills, such as communication or creativity (Wang et al., 2018, p. 12; Kong et al., 2014, p. 76). Despite the advantages of VR in education, its effectiveness also needs to be demonstrated.

2.2.1. Effectiveness of VR in education

Studies on VR training have found varying results on its effectiveness in education (Abich et al., 2021, p. 928). Li et al. (2017) have demonstrated VR training to be more effective than conventional teaching (p. 1283). The immersive VEs create a complex and content-based learning approach, which improves technical, creative, and problem-solving skills (Velev & Zlateva, 2017, p. 35). Active interaction with learning materials and direct modification of objects support learning and the building of associations. This, however, suggests that viewing non-interactive material through VR has no additional benefit (Abich et al., 2021, p. 929; Jang, Vitale, Jyung, & Black, 2017, p. 160). The technology enhances motivation, engagement and interest through the playful approach offered and the variety of possible learning styles (Parong & Mayer, 2018, p. 795; Freina

& Ott, 2015, p. 6). In particular, VR learning improves procedural knowledge, fine motor skills and enhances students' confidence in performing procedures (Abich et al., 2021, p. 925-930; Pulijala, Ma, Pears, Peebles, & Ayoub, 2018, p. 1070-1071). Studies have shown that desktop learning is more efficient than VR. Nonetheless, immersive VR training enables higher task performance and better knowledge acquisition and is overall more effective (Bailey et al., 2017, p. 9; Abich et al., 2021, p. 929).

In contrast, other studies have revealed mixed results, providing only weak to no evidence of VR effectiveness (Abich et al., 2021, p. 928). Bailey et al. (2017) have found no difference between desktop and VR training. Additionally, they could not prove a relationship between immersion and better learning outcomes (p. 8). Battussi and Chittaro (2017), likewise, were unable to prove better memorisation through higher fidelity (p. 1073). Other studies reported higher motivation of students through VR but worse post-test results (Parong & Mayer, 2018, p. 794). Researchers, however, argue that the negative results could be due to a lack of routine in learning with VR and that increased VR familiarity would improve performance (Bliss et al., 1997, p. 83-84; Abich et al., 2021, p. 930). Murcia-Lopez and Steed (2018) similarly have not found a significant difference between physical and virtual training. The researchers nonetheless, appeal for VR training as time should not be the only measure of effectiveness (p. 1583).

To overcome possible struggles of VR effectiveness, Parong and Mayer (2018) suggest using VR in combination with conventional teaching methods to arouse students' interest and motivation (p. 795). Theoretical content should, furthermore, be conveyed by utilising the interactivity VR provides. (Abich et al., 2021, p. 930). Jang et al. (2017) recommend using VR training for students with prior knowledge (p. 160). In contrast, other researchers have indicated that VR training might be more effective for students with less experience (Abich et al., 2021, p. 929; Parong & Mayer, 2018, p. 795). Hence, this implies the importance of adapting VR training to its target group (Abich et al., 2021, p. 929). Despite the partly demonstrated VR effectiveness, there is still criticism for its application in education.

2.2.2. Criticism of VR in education

According to Concannon et al. (2019), the technology should not replace traditional and established teaching methods (p. 14). One reason is the missing face-to-face interaction and hands-on experience (Velev & Zlateva, 2017, p. 36). Cochrane (2016) argued that VR offers excellent potential, but this cannot be exploited with current teaching methods. Therefore, a more student-centred approach needs to be implemented before using VR (p. 48). Secondly, immersive VR potentially causes cybersickness. Cybersickness is triggered by visual delays in VE adjustment due to refresh rates and lack of tactile feedback, creating an unrealistic and difficult-to-control environment (Rebelo et al., 2012, p. 972; Li et al., 2017, p. 9). Heavy HMDs can, additionally, exert pressure on the head causing discomfort during use (Yan, Chen, Xie, Song, & Liu, 2019, p. 248). Unnecessary movements in the VE, further, can distract and weaken students' attention (Parong & Mayer, 2018, p. 794). Kavanagh et al. (2017) have outlined that we should not forget that VR could potentially exclude some students from education (p. 108). Understanding influencing factors on VR acceptance, particularly student acceptance conditions, is vital to avoid potential exclusion.

2.3. Theoretical Framework

The success of VR in education depends considerably on the students' acceptance of the technology. Acceptance is "an antagonism to the term refusal and means the positive decision to use an innovation" (Bernd, 2001, p. 87). Various theories and frameworks explain the acceptance and adoption of new technologies (Taherdoost, 2018, p. 961). A prominent acceptance theory is the Technology Acceptance Model (TAM), which investigates *perceived ease of use* and *perceived usefulness*. One main finding is the strong correlation between the usefulness of technology and its actual usage (Davis, 1989, p. 333). TAM was widely used in technology acceptance research (Venkatesh, Morris, Davis, & Davis, 2003, p. 428). Venkatesh and Davis (2000) have, however, extended the model to TAM2 and included, among others, influences such as voluntariness, experience and output quality (p. 197). Another key theory is the Theory of Planned Behavior (TPB), which tries to explain human behaviour with *attitudes, subjective norms* and *perceived behavioral control.* The three aspects were found to correlate with human behaviour. Yet, other influences remained unresolved (Ajzen, 1991, p. 182-206).

Venkatesh et al. (2003) consolidated conceptual and empirical similarities of eight theories, including the three theories mentioned above and created the Unified Theory of Acceptance and Use of Technology (UTAUT). The models' application focuses on the organisational context (Venkatesh et al., 2003, p. 467). As students can be regarded as customers of post-secondary institutions, I applied the UTAUT2 model for my research (Guilbault, 2016, p. 137). Venkatesh et al. (2012) designed UTAUT2 to explain the technology acceptance of consumers (p. 158). The model was already used in several studies. However, its application for qualitative and VR acceptance research is rare (Tamilmani, Rana, & Dwivedi, 2017, p. 45). I only found a few studies using UTAUT or UTAUT2 in a qualitative context (Bixter, Blocker, Mitzner, Prakash, & Rogers, 2019, p. 75; Gharaibeh, Arshad, & Gharaibeh, 2018, p. 125). Janzik (2022), nevertheless, describes UTAUT2 as a reasonable basis for technology acceptance research (p. 107).

To create UTAUT2, Venkatesh et al. (2012) incurred four constructs from the original UTAUT model. These include *performance expectancy (PE),* indicating the perceived benefits gathered by technology usage, *effort expectancy (EE),* capturing the ease of use, *social influence (SoIn)* and *facilitating conditions (FC),* describing the perceived resources and support accessible (p. 159). According to Venkatesh et al. (2012), SoIn indicates whether students feel that important people, such as family or peers, think they should use VR (p. 159). This question is inapplicable at this point as VR is not yet widely employed (Janzik, 2022, p. 107-108). The focus group discussion, therefore, debated whether students perceive that important others could influence their VR adoption.

For UTAUT2, the researchers have added three constructs (Venkatesh et al., 2012, p. 158-160). The first construct is hedonic motivation (HM), describing the enjoyment of using technology. Secondly, they have added price value (PV), representing the accord between consumer benefit and monetary costs. Lastly, the construct habit (HA), refers to automated use behaviour created through technology familiarity (Venkatesh et al., 2012, p.161). However, as the diffusion of VR is limited, only a minority was able to create HA in terms of automated behaviour (Janzik, 2022, p. 107-108). Therefore, the focus group interviews aimed to find requirements VR has to meet for regular use. All constructs influence the behavioral intention (BI) of people to use a particular technology (Venkatesh et al., 2012, p. 160).

UTAUT2 further includes *use behavior.* Janzik (2022), however, argues that *use behavior* should be excluded in the VR context as only few people currently use VR (p. 107-108). The model also involves three moderating variables of *age, gender* and *experience*, which differently influence the constructs (Venkatesh et al., 2012, p. 160). As my research only studied young students with a median age of 24.5, the moderator *age* is inapplicable. Additionally, according to Janzik (2022), the moderating variable *gender* is based on merely stereotypic arguments and, therefore, should be dismissed (p. 112). Venkatesh et al. (2012) encourage the adaption of UTAUT2 to different contexts (p. 173). Therefore, I will apply a modified UTAUT2 model as seen in Figure 1, including all constructs but excluding *use behavior, gender* and *age*.

2.4. Technology Acceptance

Although UTAUT2 has not been directly applied to understand factors influencing post-secondary students' acceptance and intention to use VR in education, prior research used other technology acceptance frameworks. Disztinger, Schlögl, and Groth (2017), for example, applied TAM to research VR acceptance (p. 259). Whereas other researchers used UTAUT, UTAUT2 or combinations of theories to study general VR acceptance or specifically VR acceptance in education (Alghtani, Altameem, & Baig, 2021, p. 221-224; Shen, Ho, Kuo, & Luon, 2017, p. 130; Noble et al., 2022, p. 3-4).

Technology is primarily adopted because of its functions and users only evaluate the required effort in a second step. Therefore, perceived usefulness is more decisive than ease of use. In general, users weigh the benefits against the costs, implying that they are willing to accept difficulties if a system offers enough valuable functions (Davis, 1989, p. 333-334). Perceived usefulness from TAM can be equated with PE in UTAUT2 and perceived ease of use with EE (Venkatesh et al., 2003, p. 448-451). According to Venkatesh et al. (2012), especially PE, FC, HM and PV influence the intention to use a technology (p. 170-171).

In addition, the level of experience influences technology acceptance. Taylor and Todd (1995) have determined that, especially for inexperienced users, provided information can positively alter the intention to use a technology (p. 565). Inexperienced people further pose more importance on *perceived usefulness* (Taylor & Todd, 1995, p. 566). Contrary, Toyoda et al. (2021) have found PE to be more important for experienced users, whereas EE is crucial for inexperienced users (p. 8). People with low experience are, additionally, motivated by technology novelty, whereas experienced users search for efficiency through technology (Venkatesh et al., 2012, p. 161-163). Despite the contradictions, which construct is most influential, researchers agree that higher experience positively affects the intention to use and accept VR (Janzik, 2022, p. 243; Taylor & Todd, 1995, p. 565).

2.4.1. Acceptance of VR

Research on VR acceptance in various domains revealed several influencing factors. Janzik (2022) has found that users consider the four original UTAUT constructs as significant influences. Technology usefulness, ease of use, social acceptance, and the received support are, therefore, crucial. (p. 103). Algahtani et al. (2021) describe *HM* and *PE* as particularly influential on the intention to use VR. In contrast, *EE*, *HA*, and *SoIn* have a minor influence (p. 226). Toyoda et al. (2021), additionally, have discovered HM to be more influential compared to SoIn and EE when it comes to VR adoption (p. 10). As described, SoIn only has a minor influence, especially family is less influential compared to friends in the VR context (Janzik, 2022, p. 245). However, digital natives can barely be influenced, as they are able to evaluate technologies themselves (Toyoda et al., 2021, p. 10).

Additionally to the UTAUT2 constructs, Algahtani et al. (2021) have described satisfaction and personal innovativeness as influences on the intention to use VR (p. 222-226). Other researchers have found personal characteristics, such as innovativeness, technology readiness or sensation seeking (Sagnier, Loup-Escande, Lourdeaux, Thouvenin, & Valléry, 2020, p. 1002; Janzik (2022), p. 231). Disztinger et al. (2017) further indicated that enjoyment is decisive as VR is a hedonistic system (p. 265). Toyoda et al. (2021) also described this finding (p. 10). Sagnier et al. (2020) explained that a positive opinion about VR makes its use seem easier (p. 1001). According to Disztinger et al. (2017), nevertheless, the most substantial influence on VR acceptance is general interest (p. 265). In contrast, Janzik (2022) declared previous gaming experiences as the strongest predictor (p. 233). The feature of immersion, additionally, influences acceptance, meaning the higher the level of immersion, the more people accept VR (Disztinger et al., 2017, p. 265). Contrary, cybersickness harms the enthusiasm for usage (Sagnier et al., 2020, p. 1001). Having discussed the general VR acceptance, I now focus on the literature on the acceptance of learning technologies and VR within the educational context.

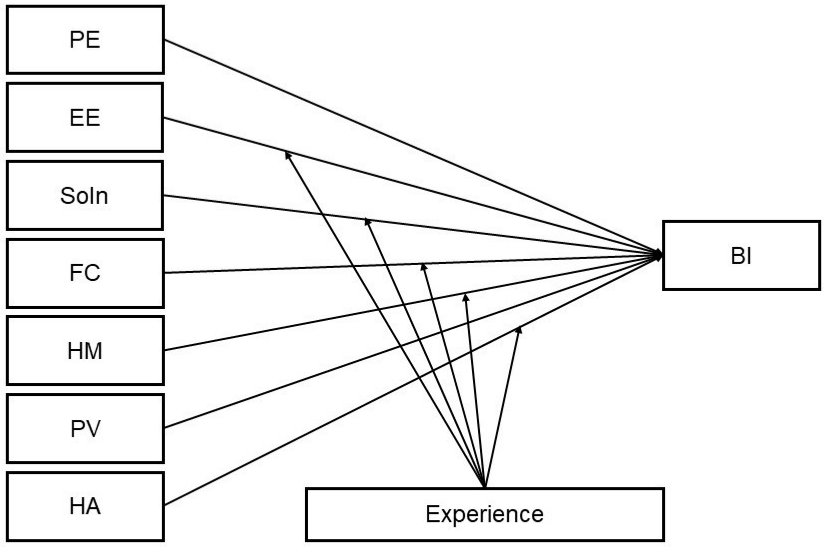

Figure 1: Modified UTAUT2 Model

Note. The modified UTAUT2 model showing the relationships of the constructs. Adapted from "Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology", by V. Venkatesh, J. Y. Thong, and X. Xu, 2012, *MIS Quarterly, 36*(1), p. 160.

2.4.2. Acceptance of technology in education

Literature on learning technologies and VR acceptance in education reveals several similarities and additions to the findings outlined above. Researchers have found *PE* most significant for students' VR acceptance (Noble et al., 2022, p. 13; Fussell & Truong, 2022, p. 260; Chahal & Rani, 2022, p. 19). Bernd (2001) especially outlined the quality of technology to be influential (p. 145). These results align with Davis (1989, p. 333) and Venkatesh et al. (2012, p. 171). Immersion, interaction and imagination positively impact PE (Huang et al., 2016, p. 15-16). Pettey (2018), nevertheless, outlined VRs' current weakness in terms of user experience, impeding its mass adoption in education (para. 3). Students evaluate the user interface according to its user-friendliness, facileness, and gratification (Zakaria, Abuhassna, & Ravindaran, 2020, p. 1291; Shen et al., 2017, p. 134). Currently, students, however, perceive VR as inconvenient in usage (Pettey, 2018, para. 4). Straightforward systems increase performance and productivity, enhancing students' use motivation, operating confidence and, in turn, technology acceptance (Chahal & Rani, 2022, p. 19; Shen et al., 2017, p. 134; Zakaria et al., 2020, p. 1291). According to Noble et al. (2022), students are willing to spend more money when they experience higher performance (p. 13).

Additionally, user competence positively affects students' technology acceptance (Bernd, 2001, p. 144). Competence can be achieved by providing training sessions and ensuring the support of the school, teachers and fellow students (Shen et al., 2017, p. 134). Even though students thought learning to operate with VR would be effortless, demonstrations on how to use and benefit from VR could improve the acceptance process (Zakaria et al., 2020, p. 1289; Fussell & Truong, 2022, p. 260). Other facilitating measures, such as providing technical or financial support or supplying equipment, encourage the active application of VR in education (Majid & Shamsudin, 2019, p. 58; Shen et al., 2017, p. 134; Bernd, 2001, p. 139). Nevertheless, not only internal facilities and resources but also external infrastructure influences the intention to use (Shen et al., 2017, p.134). Overall, the introduction and integration into the learning environment greatly influence the acceptance of VR in education (Fussell & Truong, 2022, p. 260).

Majid and Shamsudin (2019) again found attitude as an influencing factor. The researchers, however, outlined that PE can alter the attitude of users (p. 58). Likewise, Noble et al. (2022, p. 14) see attitude as a predictor of acceptance, in line with Chahal and Rani (2022, p. 19), who have found attitude and additionally personal innovativeness as influencing factors. Students perceive VR as innovative and a better application than videos (Noble et al., 2022, p. 14). Other influences on intention are perceived enjoyment and habit, so if a system is fun and fits the habits already in place, it is easier to integrate (Fussell & Truong, 2022, p. 258; Bernd, 2001, p. 144). Health risks or regulatory uncertainties were not crucial for students, which is explained by low experience and unawareness. However, these factors will gain importance in the future (Fussell & Truong, 2022, p. 261). According to Pettey (2018), educational mass adoption is avoided by experiencing eye strain and sound disorientations (para. 3). SoIn and self-efficacy can be influential, whereas SoIn only has an indirect effect. Personal innovativeness and skills training increase self-efficacy and following intention to use e-learning (Chahal & Rani, 2022, p. 18-19). In general, students see technology as means of communication and engagement. However, face-to-face provides the opportunity to network more effectively. Therefore, students prefer a blended learning environment (Gierdowski, 2019, p. 3-8).

The reviewed literature illustrates the effectiveness and usability of VR in education. The mainly quantitative studies, nevertheless, provide a superficial understanding of the factors influencing students' acceptance of VR in education. Especially, qualitative research is missing and outlines a gap in the students‘ perspective on the application of immersive VR in non-practical lectures.

3. Methodology

I undertook a qualitative empirical study to investigate the technology acceptance of post-secondary students. According to Yin (2011), qualitative studies are beneficial for conducting in-depth research on peoples‘ opinions and attitudes (p. 3-4).

3.1. Research design

The intended research design was a qualitative methodology utilising focus group interviews to collect data over a cross-sectional time horizon. The subject of this research revolved around the acceptance of VR applications in post-secondary education. The exploratory study aimed to discover factors influencing students' decision to accept the use of immersive VR applications in theory lectures. I conducted the study within the research philosophy of critical realism, which claims that cultural background and experiences influence research. Therefore, minimising biases and irregularities is crucial (Saunders et al., 2019, p. 147-148).

A profound sampling strategy can strengthen validity through a defined research context that avoids overgeneralisation (Robinson, 2014, p. 39-40). Further, bias often is a problem during interviews. Therefore, I avoided positive or negative reactions to participants' answers to minimise influence (Saunders et al., 2019, p. 460). Saunders et al. (2019) recommend examining data from different angles, making results more valid and credible (p. 451). To ensure ethical considerations, participants were informed about the purpose and the use of the collected data. At least two days before the interview, each participant received an information sheet and had to sign a consent form, which can be found in the Appendix. Before the interview started, I repeated the information and outlined that participants were free to join, leave and refuse participation (Hennink, 2014, p. 46). To ensure confidentiality and data protection, all names got coded (ALLEA, 2017, p. 6; Saunders et al., 2019, p. 272).

Focus groups are especially suitable for exploring participants' opinions, perceptions, and revealing pre-held views from the populations' point of view (Hennink, 2014, p. 2; Saunders et al., 2019, p. 470). They, additionally, encourage discussion and interaction between participants and make data occur naturally (Vaughn, Schumm, & Sinagub, 1996, p. 15). The choice of method got further substantiated by its wide use in social science research (Hennink, 2014, p. 15).

3.2. Data collection

I conducted three differing semi-structured focus group interviews. Saunders et al. (2019) suggested that four to twelve participants per focus group are desirable (p. 467). The detailed group compositions can be seen in Table 1. The first focus group consisted of five graduate students, of which three had never had contact with immersive VR applications, and two had already had first experiences. The second group consisted of five undergraduate students without prior VR knowledge. Lastly, the third group involved six undergraduate or graduate students, who had already had contact with immersive VR and were familiar with the topic. The nine male and seven female participants ranged from 19 to 31 years and had a median age of 24.5. The variety of focus groups led to information saturation, and an additional focus group was unnecessary (Hennink, 2014, p. 43). The participants were mainly contacted via LinkedIn and recruited over direct contact. The transcribed and anonymised interviews of the three focus groups can be found in the Appendix.

3.2.1. Sampling method

The participants for the three groups were selected through a multi-stage process of non-probability sampling techniques (Saunders et al., 2019, p. 325). At the focus group level, I applied heterogeneous sampling. Saunders et al. (2019) stated that heterogeneous sampling ensures diverse characteristics of the focus groups and helps to identify key themes of the research question (p. 321). The level of study and experience captured the group diversity.

On the participants' level, I firstly applied homogeneous sampling, which according to Saunders et al. (2019), supports getting in-depth results and making minor differences in opinions prominent (p. 321-322). Homogeneity and a low acquaintance support participants to contribute actively in the discussion (Hennink, 2014, p. 38-40). Secondly, I applied self-selection sampling to guarantee total voluntariness. The self-selection stage ensured the will of individuals to share their thoughts and made sure participants had an opinion on the research topic (Saunders et al., 2019, p. 323-324). The multi-stage process led to a solid research sample in ensuring a variety of information gathered through heterogeneity and depth of information through homogeneity. At the same time, self-selection ensured participants' motivation (Robinson, 2014, p. 36).

Table 1: Overview of Participants

Interviewee	Group	Age	Gender	Experience	Field of Study
A	1	25	m	low	Business Informatics
B	1	27	m	low	Medicine
C	1	25	f	low	Politics
D	1	24	m	medium	Mechatronics
E	1	25	m	medium	Business & Law
F	2	19	f	low	Business
G	2	21	f	low	Business
H	2	24	f	low	Business
I	2	24	f	low	Business
J	2	23	f	low	Law
K	3	27	m	high	Architecture
L	3	25	m	high	Software-engineering
M	3	31	f	high	Software-engineering
N	3	27	m	high	Architecture
O	3	23	m	medium	Communication & IT
P	3	24	m	high	Communication & IT

Note. Demographic data of the focus group participants divided into the three groups.

3.2.2. Procedure of data collection

Semi-structured interviews are a non-standardised method, utilising key questions as guidance (Saunders et al., 2019, p. 437). Therefore, I created a discussion guide, which can be seen in the Appendix (Hennink, 2014, p. 48). The guideline structure was deducted from the UTAUT2 constructs, and each construct included one to four key questions (Venkatesh et al., 2012, p. 160). Moderation is an essential task in group interviews and requires the critical skill of active listening (Saunders et al., 2019, p. 460-471; Hennink, 2014, p. 69-71). As a support, the discussion guide included the introductory part, prompts promoting discussion and reminders. I pretested the discussion guide with a pilot group to check the timing and comprehensibility of questions (Hennink, 2014, p. 68-69).

All three interviews took place on the same day in Innsbruck in a meeting room, which was convenient to reach for all participants (Saunders et al., 2019, p. 454). The chairs were arranged in a semi-circle so I could have direct eye contact with each interviewee. Due to the Covid-19 situation, however, facial masks were required, which reduced the ability to observe facial expressions. A research assistant was present and supported me with the recording equipment and in observing noticeable group dynamics and body language (Hennink, 2014, p. 69).

The procedure of the discussion was two-fold. I started with an introductory part showing a short explanatory video from “Horizon Workrooms” (Meta Quest, 2021). The video explained what collaboration and office work could look like with VR. Additionally, participants tried on the HMD “Oculus Quest 2” and experienced the metaverse “Spatial” as seen in Figure 2. Lastly, my introductory part included some general information. The combination of activities established common sense of the topic and lightened the group situation (Hennink, 2014, p. 56). Secondly, I conducted the discussion. All three focus group interviews lasted around 45 minutes, and every key question was posed to each group, which allowed to systematically compare the answers to each topic (Saunders et al., 2019, p. 437).

3.3. Data analysis

After fully transcribing the focus group discussions and familiarising myself with the data, I started the thematic analysis following an abductive approach. To ease the process, I used the software MAXQDA. First, I broadly and deductively coded the data with the UTAUT2 constructs (Braun & Clarke, 2006, p. 88; Venkatesh et al., 2012, p. 160). Data segments which did not fit into one of the themes were provisionally coded separately. Some segments also fitted into several themes and were coded multiple times (Braun & Clarke, 2006, p. 89). Especially, memo writing helped to collect, elaborate, and refine my ideas (Charmaz, 1996, p. 42-43). In the second step, I inductively identified subcodes to the UTAUT2 themes and tried to review and fit loose segments in. In the end, two additional themes emerged (Braun & Clarke, 2006, p. 89-91). After obtaining the structure, I analysed each theme by reviewing the interviewees’ contributions and analysing potential interrelations between themes and their subcodes. The analysis resulted in an extension of the UTAUT2 model, shown and explained in the next chapter.

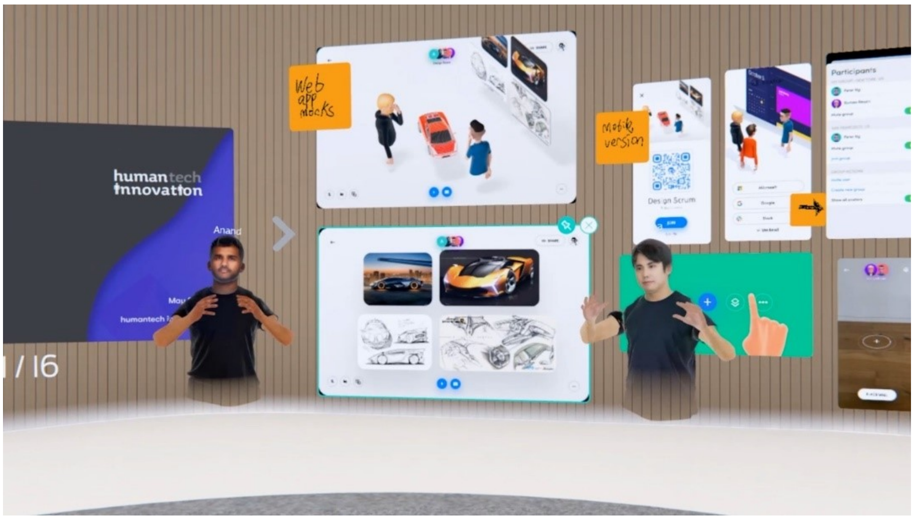

Figure 2: “Spatial” Virtual Environment

Note. VE shown to the participants before the focus group discussion started. From *Telepresence with Spatial vs. Video Conferencing,* by Spatial (2021). `https://spatial.io/blog/telepresence-vs-videoconferencing`. Copyright 2022 by Spatial Systems, Inc.

4. Results and discussion

This study addresses the factors influencing students’ acceptance of VR in theory lectures, thus contributing to the existing research concerning technology acceptance in education. To this end, the focus group discussions revealed two additional themes to the UTAUT2 constructs, namely *student innovativeness (StIn)* and *attitude (AT). Attitude can be defined as* “the degree to which a person has a favorable or unfavorable evaluation . . . of the [usage] behavior in question“ (Ajzen, 1991, p. 188). I additionally discovered underlying influencing factors of the UTAUT2 constructs. Beyond this, the analysis revealed a thematic framework including nine core themes and 18 subthemes, as presented in Figure 3.

Following this, I analysed and subsequently discussed each theme and its underlying subthemes by summarising the interviewees’ statements, underpinning them with cited examples and relating them to existing literature. I continue by evaluating the themes and subthemes in terms of their applicability to VR in post-secondary education. The following section is structured according to the core themes and ends with a proposed extension of the UTAUT2 model.

4.1. Core themes

4.1.1. Performance expectancy

Across all three focus groups, PE was the most widely discussed topic. Concerns regarding VR in non-practical lectures were widespread. Participants mostly declared VR as not applicable for theory education, such as person E, who misses “the added value, especially in theory lectures” (I1, para. 39). Other participants agreed, “because what is the advantage? As it is only listening and no practical tasks” (I3, para. 27). One interviewee with no technical background, however, suggested how universities could effectively apply VR in a theoretical context:

> I can imagine that a professor ... wants to explain a certain topic, such as “organisation”. So, all the information ... can also be visualised. How can you imagine that [an organisation]? Perhaps that could create a greater practical relevance .... Or also in human resources, ... one could be the boss and learn how to deal with a dismissal. That you can do some kind of role play. (I2, para. 51)

Other participants mentioned theoretical applications such as history, economic lectures or anxiety therapy. Most participants, however, envisioned using VR for practical lectures, such as in medicine or technical fields. Students with technical backgrounds especially mentioned joint prototyping and reviewing architectural or mechanical work. As for the reason, one interviewee outlined that, “It definitely helps if you first have it on the computer and afterwards in VR before you buy anything. This is where you can also save time and money” (I1, para. 62).

Interestingly, participants also discussed VRs’ influence over access to education. Interviewees, specifically, raised concerns that the required HMDs may be prohibitively expensive for some students or that the technology may not work as required. In contrast, other respondents noted that VR could improve the situation for some people by enabling a better and easier connection worldwide:

> I see a lot of potential, maybe not for everyone, but maybe for people who are limited, who cannot move and cannot come to the university. So, targeting some groups would make sense. Even if someone wants to study at Harvard and cannot find an apartment . . . he can still participate. (I3, para. 142)

A common view amongst interviewees was that VR pro-

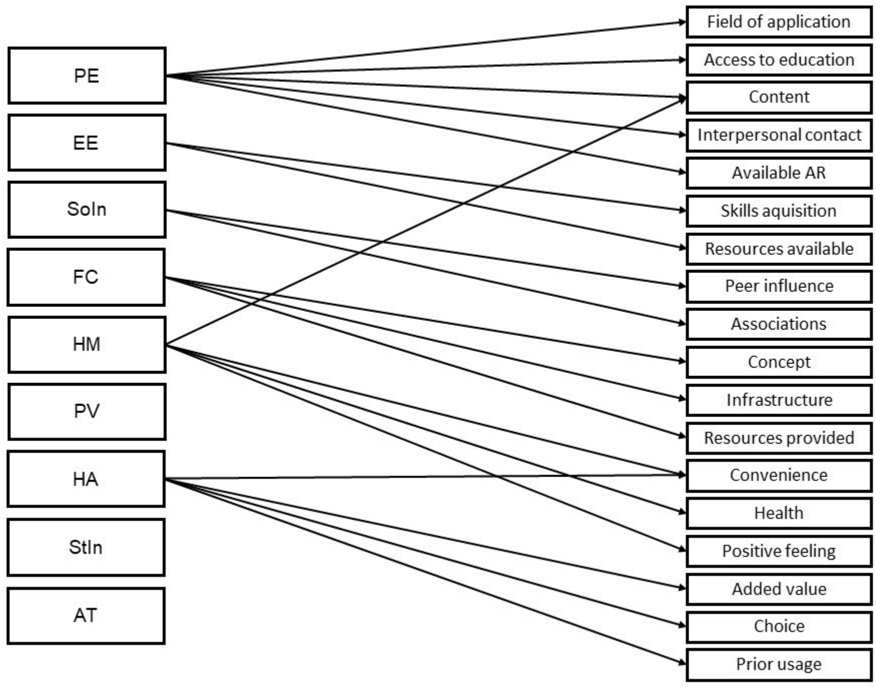

Figure 3: Thematic Framework

Note. The thematic framework after the analysis, revealing two additional constructs and 18 subthemes.

vides a different teaching environment from face-to-face lectures. Person P argued that it is necessary "to adapt the entire teaching content. Because the way you teach now ... would be nothing for VR goggles" (I3, para. 48). Additionally, as person F indicated, "I would find it strange to see only avatars all the time and no real people at all" (I2, para. 58). Student L, moreover, claimed, "It depends on how the content is made and that probably takes many years to produce a cool teaching content" (I3, para. 100). Others referred to new opportunities, such as visualisations, individualised and realistic avatars, or easy guest visits from international professors. The following quote represents a shared opinion from groups two and three regarding the VE experienced:

> I think the question is how this space will look like. Because if we now see the metaverse, for example ... that seems childish. I don't know whether the lecture should be like that, and I don't know how seriously I could take it. The question is if we have our bodies somehow scanned through other technologies and then being projected in a more realistic way. (I3, para. 39)

All interviewees remarked on VRs' influence over interpersonal contact. Some interviewees agreed on VRs' benefits for group work, presentations and interactivity in the classroom. As person M outlined, "Online [desktop collaboration] it is difficult ... that two people are talking at the same time. You can't stand away a bit to talk ... and you can't say anything because otherwise you don't understand the others" (I3, para. 131). Meanwhile, other students indicated that they prefer real over virtual contact and that the Covid-19 pandemic could have influenced this preference. As student E argued, "There is still something lost I don't think an avatar can and will replace" (I1, para. 130). Missing body language, facial expressions and eye contact make it significantly more difficult to communicate through VR, as outlined by student K:

> The whole facial expression, the face is not yet scanned, the whole body language, and so on. You probably have your avatar that tells you something, but still something is missing. If everything is scanned ... and in real-time, then it might work. (I3, para. 103)

Interestingly, a few interviewees brought up related technologies such as AR, which student P perceived as "certainly more interesting, especially because I think that studying should remain face-to-face" (I3, para. 96). Out of the results, five subthemes emerged regarding PE. These include field of application, access to education, content, interpersonal contact, and available AR. Further analysis revealed relationships between the subcodes content and access to education and content and field of application.

The number of interviewee contributions to the theme PE suggest its powerful influence over VR acceptance. This finding is consistent with those of Venkatesh et al. (2012, p. 171) and Noble et al. (2022, p. 13). The results imply five subthemes influencing PE. The first possible influence concerns the field of application. However, this result has not previously been described. Nevertheless, the participants' suggestion for a possible theoretical application remains in line with findings from Freina and Ott (2015), who stated that VR can aid in learning to cope with difficult emotions (p. 4). Most participants, however, focused on VRs' practical applications. In particular, students with a technical background could hardly imagine that VR could be used in theoretical education. Therefore, it seems that the field of study influences the identified field of application and subsequently, perhaps VRs' acceptance in theory education. Another possible explanation for the preferred practical application comes from the already widespread educational usage of VR in medicine or engineering (Huang et al., 2016, p. 3; Wang et al., 2018, p. 1). However, the literature does not provide sufficient evidence to assume the field of application influences PE.

Furthermore, the findings imply that PE is influenced by access to education. This result is not fully confirmed by other researchers, yet the discovered opportunity for disabled students remains consistent with findings from Freina and Ott (2015, p. 6). These results, additionally, match those from Rebelo et al. (2012), who demonstrated the improved access to other locations through VR (p. 970). Comparing the findings against those from Kavanagh et al. (2017) further confirms that VR applications can lead to potential exclusion of students (p. 108). In general, it seems that access to education can be improved, but also worsened, by the use of VR. However, these results should be interpreted with caution, as the comparable literature does not assess the influence on VR acceptance. As such, there remains no evidence that access to education influences PE, and so this subtheme is not considered further.

The third possible influence involves content. In accordance with this finding, Zakaria et al. (2020, p. 1291) and Shen et al. (2017, p. 134) found the user interface to be an important influence over acceptance. My results further support the idea of Bernd (2001), who found that VR quality influences students' use intention (p. 145). Abich et al. (2021), meanwhile, reinforced the importance of content adaption for leveraging VRs' potential, which is in accordance with participant contributions (p. 928). According to strong overlap with literature, I include content as an influence of PE. Additionally, content revealed a relationship with field of application and access to education. In turn, this indicates an indirect influence by both excluded subthemes.

Continuing, the results further suggest an influence of interpersonal contact. These results match those obtained by Gierdowski (2019), who determined that students see technology as a means of communication and engagement (p. 3). My results concerning face-to-face interaction seem to be consistent with Gierdowski (2019, p. 3) and Velev and Zlateva (2017, p. 36), who found face-to-face interaction to be missing in a VE. Nevertheless, this demonstrates little evidence concerning how interpersonal contact influences acceptance. One possible explanation for the lack of literature on this topic could be the Covid-19 pandemic, as students remained unaware of the importance of face-to-face contact and the impact of its absence beforehand. As the majority of participants strengthened the importance of interpersonal contact, I suggest it as an influence over PE.

One unanticipated finding concerned the indicated influence of available AR, which has not previously been described. One possible explanation for this finding could be the wish for a blended learning environment and the fear of losing face-to-face interactions (Gierdowski, 2019, p. 8), as VR can produce an exclusionary effect over the social environment. Contrary, AR belongs to mixed realities, and thus does not fully shield users from the outside world (Janzik, 2022, p. 110; Milgram & Kishino, 1994, p. 1327). Nevertheless, there remains no evidence provided that available AR influences VR acceptance. Therefore, it is excluded.

4.1.2. Effort expectancy

Regarding EE, participants indicated whether they consider adaption to VR lectures as difficult. The majority of interviewees indicated that they do not believe adjusting to the new environment would require much effort. As student F argued, "I've been switching back and forth between online, hybrid, and face-to-face regularly in my last two years of school and even now in my first year of college. I'm actually pretty good at adapting to the situation quickly" (I2, para. 32). In all cases, participants stated that for young, tech-savvy students, it might take a short time to become familiar with the equipment, but older generations might struggle:

> I think it also depends on how the professors deal with it, because during the online conversion, you saw that with some, it worked super well and with others after two years, it still doesn't work to set up Big Blue Button in a way we are allowed to speak. (I2, para. 35)

The majority of interviewees agreed that only a few adaptions to the learning space are required, and resources such as laptop and Wi-Fi are available, with exception of VR equipment. Nevertheless, student P "could imagine that there are courses of study where perhaps not everyone has a laptop" (I3, para. 43), implying that not all study programmes are digitalised enough to begin using VR. In contrast, student L invalidates this claim, as, "Theoretically, you could make it optional that those who don't have one [an HMD] just look at it on the screen" (I3, para. 114). Out of this discussion, two subthemes for *EE* emerged: *skills acquisition* and *resources available*. Further analysis revealed that *resources available* related to a subtheme discussed later, namely, *resources provided*.

Consistent with the literature from Davis (1989, p. 333-334) and Algahtani et al. (2021, p. 226), the interviewee contributions suggest that EE bears a relatively weak influence over students' VR acceptance as they perceive non to low effort. Therefore, students might narrowly consider EE in their decision for adoption. The data further indicate that

EE is influenced by *skills acquisition.* The finding that students do not perceive effort for adapting and acquire skills is consistent with Zakaria et al. (2020, p. 1289). This self-efficacy also positively influences the adoption of VR (Chahal & Rani, 2022, p. 18). The Covid-19 pandemic may help explain the low perceived effort, as students became accustomed to switching back and forth between teaching concepts and technologies. Interviewees, nevertheless, still perceived that the older generation could struggle with adaption. However, as students do not necessarily need to adapt their skill set, and thus do not consider it a factor of acceptance, I will exclude skills acquisition.

Additionally, my findings imply the influence of *resources available.* This result has not previously been described, but studies such as those by Majid and Shamsudin (2019, p. 58) and Shen et al. (2017, p. 134) have confirmed the importance of resources *provided*. One possible explanation for this literature gap on already available resources might be that, in education, equipment is often provided by the institution and self-procurement has not been addressed so far. As my analysis suggests a relationship between both subthemes, I merge them into the "resources" subtheme and suggest it as an influence over EE. I assume this influence as failing to provide equipment would tremendously increase the required effort by students, subsequently diminishing VRs' acceptance as a result.

4.1.3. Social influence

The questions in the focus group discussion regarding SoIn aimed at emphasising whether students perceived that, important others could influence them. Student C argued that they feel "the five people with whom you do the most influence you. So, I think that's true because people influence what you do" (I1, para. 74). Another interviewee indicated family members as an influence:

> If my father buys a pair of [VR] goggles and says they are so good for different things, I can imagine being persuaded, even if I don't know anything about them beforehand or wouldn't have needed them before. (I2, para. 77)

By contrast, student I considered, "I think it also depends on the interest because men are perhaps more interested than women in such things" (I2, para. 76). Most interviewees additionally made clear associations with games or companies when thinking about VR, but they remained unable to indicate whether this influences their usage decision. Out of the discussion, two subthemes regarding *SoIn* emerged: *peer influence* and *associations.*

The number of interviewee contributions indicates that SoIn plays a minor role in VR acceptance, which is supported by Algahtani et al. (2021, p. 226). The influence of family members, meanwhile, is contrary to previous studies from Janzik (2022), which indicated that family plays a minor role, especially in VR acceptance (p. 245). This inconsistency may be due to an intense personal bond between the respondent and their family members, although this may not apply to the majority. The result concerning the influence of general interest is in line with Disztinger et al. (2017), though it bears little applicability to SoIn (p. 265). Toyoda et al. (2021) found that digital natives barely are influence by others in their technology usage decisions, indicating that peer influence is not applicable in this context, as students are primarily digital natives (p. 10). The findings remain in addition unable to demonstrate an influence of associations, and there is no supporting literature. Therefore, the subthemes are dropped, and SoIn remains a minor influence over VR acceptance.

4.1.4. Facilitating conditions

A common view amongst interviewees, regarding FC, concerned the importance of a study concept and a plan for introducing the new study format. As student L argued, "It is not only the glasses, but you also need a concept. Therefore, I imagine that to be difficult" (I3, para. 51). Contributions strongly overlapped with the subtheme *content*, as demonstrated in the following quote:

> The question is, how is this enforced? If there are 30 people, do I sit in my chair because it's supposed to be a lecture? Or ... do I look through the VR goggles? Or am I so limited that I can only see a part [of the VE]. (I3, para. 29)

One interviewee recommended clear communication regarding the amount of usage and required equipment to avoid confusion. Participants on the whole, demonstrated the importance of training sessions. Interviewee J argued, "I also think that introductory courses are important. I think that the university would be obliged to offer them for a week at the beginning of the semester" (I2, para. 39).

The theme of *infrastructure also* recurred throughout the data set. Student E claimed that "reliability of the platform in use, . . . and the internet connection must be given" (I1, para. 103) because otherwise, VR lectures could be frustrating. One interviewee added that "data protection may also have to be reliable depending on which applications are used" (I1, para. 109). As for another topic, the majority of interviewees concurred that "everyone has the right to study and should also have the same opportunities" (I3, para. 50). Therefore, the institution should at least offer education prices for VR equipment, but "it would make sense if the university provided at least a certain number of VR goggles and all the necessary equipment" (I2, para. 37), student G stated. Contrasting slightly, two students argued the following:

> I mean, nowadays the university is not obliged to provide laptops because everybody has them now. It's just a question of when [we are at that point with VR]. But now I think help should be offered because I don't think every student can afford it. (I1, para. 46)

Additionally, the institution should introduce a support system, as student N was concerned about issues where "someone has technical problems, for example. Who solves that? Is that the professor, or the student alone or is there support?" (I3, para. 45). Out of the discussion, three subthemes for *FC* emerged, namely, *concept, infrastructure* and *resources* provided.

Consistent with Venkatesh et al. (2012, p. 169-171), the number of interviewee contributions suggest FC as a highly influential factor over students' acceptance. The collected data indicate that *concept, which includes planned introduction and clear communication,* influences *FC*. This result matches those observed by Fussell and Truong (2022), who found that the way of introducing and integrating VR influences technology acceptance (p. 260). The subthemes of concept and content overlap, but I treat them as separate influences as concept relates more to the way of introduction. As most interviewees questioned the concept, I include this as an influencing factor over FC.

The finding that *infrastructure* influences *FC* remains consistent with the findings of Shen et al. (2017, p. 134). Surprisingly, interviewees outlined the importance of data protection. In contrast, Fussell and Truong (2022) found that regulatory uncertainties were insignificant for students (p. 261). This inconsistency may be due to the technical background of the contributing participant. Nevertheless, a participant with non-technical background contributed the same. Therefore, it seems that the awareness of data security overall has increased. According to the data, I include *infrastructure* as an influence over *FC*.

Beyond this, my research indicates that the *resources provided* are influential. To this end, researchers such as Shen et al. (2017, p. 134) and Majid and Shamsudin (2019, p. 58) outlined the importance of training sessions, providing technical or financial support and supplying equipment to students. As stated earlier, resources provided relates to resources available and thus are merged to the resources subtheme. According to the strong overlap with the literature, I suggest resources as an influence over FC.

4.1.5. Hedonic motivation

As influences on HM, interviewees, for instance, reported that VR *content* would reduce their pleasure, as it is barely available currently. As outlined by student N, who already had VR experience:

> The question arose, what can I actually do in it [the VE]? What possibilities are there in the next few years? But somehow, it hasn't expanded so blatantly ..., it's somehow nothing new and you can then also just stop using it. (I3, para. 87)

Additionally, the unrealistic presentation caused negative emotions, as student F argued, "I can't imagine looking at a comic all day long" (I2, para. 93). Interviewees would, however, derive pleasure if VR offered practical applications. As student K claimed, "The digital world has to offer me added value" (I3, para. 121).

The subtheme of *convenience* came up while discussing the VR equipment. The majority indicated that using VR seems to be more exhausting compared to online or face-to-face lectures. Student O argued, "I imagine it to be rather exhausting. I don't think it makes things any easier. So, it's exhausting for the eyes and it's also quite hard to have the thing on your head all day" (3, para. 32). This theme goes hand in hand with health concerns. Some interviewees reported having experienced cybersickness or were afraid of eye damage. Student C considered, "I don't know how it is for your health or in how far it is not just too exhausting for me, also for the body and for the psyche" (I1, para. 113).

Regarding feelings, some interviewees felt neutral about their VR experience and described it as confusing or needing to get used to it, meanwhile others perceived positive feelings such as fascination, curiosity, or a feeling of being "completely thrilled". One interviewee described, "You have the feeling you're in a new place now, you can actually do whatever you want" (I3, para. 82). Out of this extensive discussion, four subthemes for *HM* emerged: *content*, *convenience*, *health* and *positive feelings.*

Consistent with Venkatesh et al. (2012, p. 169-171) and Algahtani et al. (2021, p. 226), the interviewee contributions suggest *HM* as a highly influential factor over students' acceptance. My results indicate that *HM* is influenced by *content.* This finding accords with Bernd (2001), who outlined the influence of content quality on VR acceptance (p. 145). Content quality seems to offer a possible explanation for the participants' rejection of the unrealistic presentation. Realism of VEs, further, influence the level of immersion (Rebelo et al., 2012, p. 971) and according to Disztinger et al. (2017), a higher immersion level positively influences acceptance (p. 265). In contrast to Abich et al. (2021, p. 923), interviewees criticised the barely available VR content. Furthermore, researchers such as Rebelo et al. (2012, p. 971) or Freina and Ott (2015, p. 4-6) outlined added value through VR, but according to the contributions, students still need to be convinced. Corresponding to the data, I include *content* as an influence over *HM*.

The results, additionally, indicate convenience as an influence, which is broadly supported by Pettey (2018, para. 4). The literature suggests convenience in terms of user-friendliness to influence acceptance (Zakaria et al., 2020, p. 1291). Even though there is no evidence for the influence of wearing comfort, Yan et al. (2019) still prove the experienced discomfort through heavy HMDs (p. 248). The reason why the participants posed such importance on wearing comfort was probably caused by the assumption VR lectures would last the entire day. As the influence of convenience in terms of wearing comfort is not supported by literature, I exclude it.

Furthermore, the finding that *health* influences *HM* is consistent with the findings of Sagnier et al. (2020), who determined that cybersickness reduces acceptance (p. 1001). Additionally, findings from Pettey (2018) supported this, discovering that caused eye strain prevents mass adoption of VR (para. 3). Slightly contradictory are findings from Fussell and Truong (2022), who did not identify such an influence. Nevertheless, they argued that this topic would be important in the future (p. 261). According to this overlap with literature, health is suggested to influence HM.

Lastly, the results suggest that positive feelings influence HM. These results match those obtained in earlier studies from Disztinger et al. (2017), who determined that enjoyment is crucial for VR acceptance (p. 265). Additionally, Toyoda et al. (2021) discovered perceived fun as an influence on VR acceptance (p. 9). Both findings and literature imply an influence of enjoyment on HM.

4.1.6. Price value

The opinion regarding PV was similar among the interviewees. The following quote represents the interviewees' common view:

> The costs also have a significant impact because I don't think it will work if someone doesn't get them [VR glasses] from the university, for example, or if they're not cheaper. Not everyone has money or can afford it financially. (I3, para. 128)

The majority argued that the institution had to provide financial support or offer education prices. Interviewee H pointed out, "I'm more of a fan of face-to-face lectures and wouldn't be happy at all even if I only had to spend € 100" (I2, para. 89). Consequently, the respondents argued that any necessary payment could lead to resistance to the introduction of VR lectures. Further analysis revealed a relation between *PV* and *resources*. The results on PV did not indicate any subthemes but they confirmed the influence of PV on acceptance.

Considering the interviewee contributions, PV possesses only medium importance. This outcome is contrary to Venkatesh et al. (2012), who found PV to exert a strong influence on technology acceptance (p. 171). A possible explanation for this inconsistency might be that students can be regarded as customers of universities (Guilbault, 2016, p. 137). However, universities often provide equipment or financial support to their students, just as companies do for their employees. In turn, this would also explain why PV strongly overlaps with the subtheme resources as students either ask for provided equipment or financial support. According to Noble et al. (2022), students are typically willing to spend more money if technology increases their performance (p. 13). Due to limited diffusion, however, most students could not experience higher performance through VR, and according to the answers, respondents are not willing to spend more money. Corresponding to this discussion, PV influences acceptance. It is, however, less influential in the educational context than in the consumer context.

4.1.7. Habit

For the topic of HA, the respondents named requirements that VR must fulfil in order for them to use it regularly. A common theme amongst interviewees included the *convenience* of wearing comfort and a simple user interface. Student H explained, "In terms of wearing comfort, VR goggles should perhaps be more like normal glasses" (I2, para. 94). In another group, student D added that it should have "an operating system that is also used on mobile phones ... so you don't have to learn anything new. It should be simple and not complicated" (I1, para. 104).

The topic of *added value* recurred throughout the dataset. Interviewees defined added value as better interaction in lectures, valuable use cases, a well-designed teaching environment and high-quality applications. Additionally, the utilisation should be meaningful "Because if it works just as well or better with the laptop, then why the VR goggles" (I3, para. 127). Student O outlined a common group understanding:

> For me, it depends on what you can do with it. I wouldn't just wear it and see what the day brings, but if you say there's a great game or other use cases that I imagine would be cool, then I would use it. (I3, para. 93)

Interestingly, students still preferred face-to-face lectures and mentioned *choice* as a prerequisite for regular usage. Participant I argued, "I would welcome it in addition to the lessons because probably it will be an important aspect in the future" (I2, para. 101). Student C further outlined the following:

> I find it difficult to say that all courses are now virtual because I still think it's nice to be present at the university. It would be pleasant to say, ok, we have a situation, like Corona, we all can't go to the university. Or in practical courses, it [VR] is used as an addition .... But I wouldn't say that it should completely replace the normal way of having lectures. (I1, para. 20)

Approximately half of the students already used VR in advance in gaming or within a technical study programme. Out of the discussion, four subthemes emerged for HA: *convenience, added value, choice, and prior usage.*

According to the focus group discussions, no interviewees were able to create HA for VR. However, they outlined different prerequisites for them to create it. Therefore, it seems that, especially at this point, HA has only a minor influence on students' acceptance. These findings are in agreement with Algahtani et al. (2021), who identified HA as a minor influence over VR acceptance (p. 226). The first possible influence on HA is convenience. As mentioned earlier, the influence of wearing comfort is barely supported by the literature. However, convenience in terms of user interface reflects the results of Zakaria et al. (2020, p. 1291) and Shen et al. (2017, p. 134), both of whom confirmed the influence of user-friendliness and facileness of interface for VR acceptance. Chahal and Rani (2022) also discovered that easy-to-use systems increase motivation to use and thus support the emergence of HA (p. 19). Out of this discussion, I suggest that convenience influences HA.

Additionally, the finding of added value influencing HA is consistent with Davis (1989), who noticed that users are willing to accept difficulties when a system offers benefits (p. 333-334). The results also support Fussell and Truong (2022), who determined the integration into the current learning environment to be crucial (p. 260). However, it seems that the discussed subjects within added value overlap with the subtheme content. For example, the findings again support Zakaria et al. (2020, p. 1291) and Shen et al. (2017, p. 134), who observed that the user-interface influences acceptance. Therefore, I merge added value with content and assume an influence on HA.

One unanticipated finding concerned the influence of choice. This result, however, has not previously been described. It seems possible that, especially after the Covid-19 pandemic, students have become increasingly aware of the importance of face-to-face communication, and thus are afraid of losing it again. Meanwhile, the interviewees know the convenience of working from home and want a choice. Nevertheless, no evidence has been provided that choice influences HA. Therefore, it is excluded.

Interviewees indicated that they had already used VR previously, especially in gaming. However, the participants did not indicate if they were more willing to use VR due to their prior usage. Regardless, Janzik (2022) identified previous gaming experience is one of the strongest influences for acceptance (p. 233). According to this finding, I suggest prior usage as influencing factor for HA.

4.1.8. Student innovativeness

Yet another theme to emerge from the data concerns StIn. Interviewees indicated that students are responsible for being innovative and remaining updated with technological advancements. One interviewee argued:

> Yes, it would be an effort [to introduce VR], but on the other hand ... I am asking myself: We are students, and we should go with the progress and be innovative. How far is it perhaps our duty, ... because I think it's questionable that youth or a student cannot master that [VR] at the end of the study. (I1, para. 34)

This view was echoed by other focus group participants, such as by student I, who stated, “I think it [VR] is part of it like all the other opportunities I think it's important for our education” (I2, para. 101).

The contributions imply that *StIn* influences students' *BI*. This result is consistent with findings from Algahtani et al. (2021, p. 222-226), and Chahal and Rani (2022, p. 19), who found that personal innovativeness strongly influences the intention to use VR. Conversely, however, Sagnier et al. (2020, p. 1002) found personal innovativeness to be more of an indirect influence. One possible explanation for its only indirect influence could be that innovative users perceive less effort or have more available FC, following their innovativeness influences other constructs. However, according to the still substantial overlap with literature, I suggest StIn as a direct influence over BI.

4.1.9. Attitude

Continuing, AT emerged as an additional theme for UTAUT2 constructs. During the interviews, participants frequently expressed their *AT* towards VR in education. One interviewee indicated, “I think there are a lot of options. I already see it as the future” (I3, para. 142). Another participant added, “I believe that it will be a support at some point” (I1, para. 79). By contrast, other interviewees argued, “On the education aspect, it doesn't make sense to me currently” (I3, para. 135). Some participants also made clear that VR is only entertainment for them and not applicable for education.

Nonetheless, other interviewees explained how their AT could be altered. For example, as student G argued, “I think it has a lot to do with habit, that if you have more hands-on experience, eventually you will get used to it and accept it more” (I2, para. 118). A more diverse offer of applications, improved quality of lectures, or regular confrontation in use cases could further change AT.

The interview contributions suggest that AT influences BI, which supports the findings from Majid and Shamsudin (2019, p. 58) and Chahal and Rani (2022, p. 19). Noble et al. (2022) also determined that students perceive VR to be a better solution than videos, implying the influence of AT (p. 14). Outlined factors, such as content or teaching environment, which could alter students' attitude, overlap with themes from PE, which is supported by Majid and Shamsudin (2019, p. 58). According to this substantial overlap with literature, I suggest AT as an influence over BI.

4.2. Experience

Experience as a moderating variable in the UTAUT2 model influences the constructs outlined above. Through the focus groups' different experience levels, it was possible to compare its influence in the VR acceptance context. Surprisingly, experienced interviewees mentioned more negative comments compared to inexperienced participants. Student K claimed, "For me the fascination is always brief and then I want to put it off again, because I would rather be in the real world" (I3, para. 84). The interviewee further added, “I think that perhaps too many impressions could arise, that it becomes too exhausting in the digital world, that one simply needs a break" (I3, para. 46). Several participants also expressed their hope for education to remain face-to-face.

By contrast, some VR experienced students with a technical background also expressed strong positive feelings, such as student L, "I'm totally optimistic, if the whole financial issue gets sorted out for everyone and good content is made" (I3, para. 143). Inexperienced participants with no technical background, meanwhile, were more neutral about their feelings but believed future familiarity and increasing offerings could change their opinion. For instance, student F argued, "The experience that it just functions well could also change our mind" (I2, para. 117).

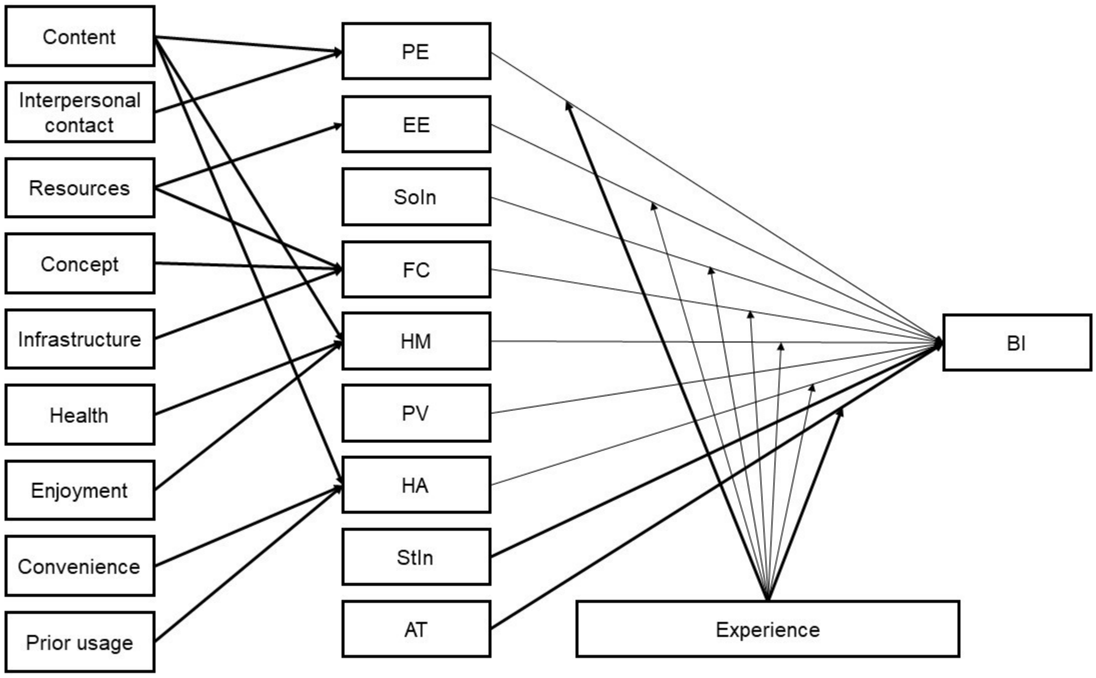

Figure 4: Extended UTAUT2 Model

Note. Proposed extension to the UTAUT2 model. Adapted from "Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology", by V. Venkatesh, J. Y. Thong, and X. Xu, 2012, *MIS Quarterly, 36*(1), p. 160.

According to the participant contributions, experience influences the core constructs influencing BI. This result is consistent with Janzik (2022), who found experience to be a strong predictor of VR acceptance (p. 243). Nevertheless, my findings reveal predominantly negative comments by experienced interviewees, contrary to Janzik (2022) findings, who found experience to be a positive influence over acceptance (p. 243). This inconsistency could be explained by cybersickness experienced by interviewees, missing usability of the system or missing content availability. For instance, Toyoda et al. (2021) suggested that PE is more important for users with higher levels of experience (p. 8). Whereas inexperienced need more information to be provided which is also suggested by my results (Taylor & Todd, 1995, p. 565). According to this discussion, I suggest that experience influences EE, SoIn, FC, HM and HA as in the original UTAUT2 model (Venkatesh et al., 2012, p. 160). I further assume that experience influences PE and AT.

4.3. Extended UTAUT2 model

According to the themes discussed, I created a proposition for an extension of UTAUT2, as presented in Figure 4. After analysing and discussing the nine themes, the before identified subthemes were reduced to nine influencing factors. The combination of results leads to the conceptual assumption that the upstream factors influence the nine constructs as indicated by the lines.

In turn, the constructs are influenced by the upstream factors of content, interpersonal contact, resources, concept, infrastructure, health, enjoyment, convenience, and prior usage. One significant finding is that content, especially, is suggested to be an important influencing factor for the constructs PE, HM, and HA. The factor content includes unrestricted guest lectures and generally content adaption to VEs to make lessons more engaging, effective, and collaborative. Another significant finding concerns the two new constructs, StIn and AT, directly influencing BI. Both constructs strongly correlate with BI in other research (Algahtani et al., 2021, p. 226; Majid & Shamsudin, 2019, p. 58). The strongest influences on the students' intention to use VR, however, comprise PE, FC and HM, which correlates with findings from Venkatesh et al. (2012, p. 169-171)

The new influence of experience on PE is based on Toyoda et al. (2021), who found that experience level positively influences PE. In turn, this suggests that users with higher experience ask for better performance (p. 8). This phenomenon was also reflected in the participants' contributions. As PE can alter AT, I further assume AT to be moderated by experience (Majid & Shamsudin, 2019, p. 58). According to the results of my study, it seems that attitude toward VR is reinforced positively or negatively depending on the experiences students have had, whereas inexperienced users' attitude remains neutral. The findings of this study reveal that post-secondary students' VR acceptance can be influenced in various ways and remains dependent on their experience with the technology. However, as I conducted a qualitative study, caution must be applied, as the findings are not generalisable and remain somewhat specific to the data's context.

5. Conclusion

This study aimed to identify factors influencing post-secondary students' decision to accept the use of immersive VR applications in non-practical lectures. To this end, this study applied a qualitative approach utilising focus group interviews. I subsequently analysed and discussed the gathered data within the scope of a modified UTAUT2 model and encompassed new factors relevant to students' VR acceptance.

The outcomes of this research possess several theoretical implications. First, this study contributes to the body of knowledge concerning VR acceptance and adoption (Fussell & Truong, 2022, p. 249; Noble et al., 2022, p. 1). The research confirms the relevance and applicability of UTAUT2 in identifying technology acceptance (Venkatesh et al., 2012, p. 160). VR acceptance is, however, not solely influenced by the UTAUT2 constructs, but additional influences have to be considered. These supplementary influences are upstream factors, including content, interpersonal contact, resources, concept, infrastructure, health, enjoyment, convenience and prior usage. The context-specific factors subsequently influence the core constructs. This research, furthermore, proposes two additional core constructs, StIn and AT, to be integrated, as they may be relevant for understanding students' intention to use VR. Additionally, I incurred the moderating variable experience, which influences all constructs except PV and StIn. The resulting context-specific extension of the UTAUT2 model, supports the adaption and implementation of VR for educational purposes while ensuring students' acceptance.

In terms of practical implications, this study primarily offers insights for post-secondary institutions considering whether to implement VR as a means of education. Teaching can benefit from VR applications, though students' acceptance remains crucial for successful implementation (Fussell & Truong, 2022, p. 260). According to the results, universities should consider underlying influencing factors and core constructs. This comprehension is vital to ensure students' VR acceptance and avoid a drop in academic performance. Additionally, companies can use the results to understand their customers' acceptance of VR training. Therefore, the suggested model extension informs decision-makers about possible influencing factors and supports them in identifying measures to increase VR acceptance in theory education.

Nonetheless, this research possesses certain limitations that should be pointed out. First, it should be emphasised that the findings demonstrate subjective appraisal by a small number of students, which is caused by the sample size of 16 participants. Additionally, due to time restrictions, the time to conduct the focus group interviews was limited. As such, all interviews took place on the same day, which might have influenced my concentration while moderating. With more available time, additional focus groups could have been conducted. In turn, the added data might have changed the UTAUT2 model extension. Another limitation is the interviewer bias, which means how I posed questions or behaved could have influenced the participants' answers (Saunders et al., 2019, p. 447). Even though the participants of the focus groups came from different study fields and had various VR experience levels, the qualitative study is still not generalisable.

These limitations leave ample room for further research. I suggest that future research additionally assesses the moderating variable of age as it possibly influences the acceptance of VR. Furthermore, VRs' potential diffusion into post-secondary education will offer richer and more accurate insights into students' acceptance of the technology. In particular, I recommend researching the influence of HA and SoIn as these two constructs could gain influence (Janzik, 2022, p. 107-108). Finally, my research identifies several factors influencing post-secondary students' VR acceptance, summarised in the proposed extension of the UTAUT2 model. I recommend future quantitative and qualitative research to confirm and adjust the identified factors in their applicability to the context of VR in university education. In particular, to provide educational institutions with a solid decision-making basis for successfully introducing VR while ensuring students' acceptance.

References

Abich, J., Parker, J., Murphy, J. S., & Eudy, M. (2021). A review of the evidence for training effectiveness with virtual reality technology. *Virtual Reality*, *25*, 919–933.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211.

Algahtani, M., Altameem, A., & Baig, A. R. (2021). An Extended UTAUT2 model to Explain the Adoption of Virtual Reality Technology in Health Centers: An Empirical Study Based in Riyadh. *IJCSNS International Journal of Computer Science and Network Security*, *21*(3), 219–228.

Alkhamisi, A. O., & Monowar, M. M. (2013). Rise of Augmented Reality: Current and Future Application Areas. *International Journal of Internet and Distributed Systems*, *1*(4), 25–34.

ALLEA. (2017). *The European Code of Conduct for Research Integrity: Revised Edition. All European Academies.* https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/european-code-of-conduct-for-research-integrity_horizon_en.pdf.

Almossa, S. Y. (2021). University students' perspectives toward learning and assessment during COVID-19. *Education and Information Technologies*, *26*, 7163–7181.

Bailey, S. K., Johnson, C. I., Schroeder, B. L., & Marraffino, M. D. (Eds.). (2017). Using Virtual Reality for Training Maintenance Procedures. *Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC), Orlando*. Retrieved from https://www.researchgate.net/publication/321335824_Using_Virtual_Reality_for_Training_Maintenance_Procedures

Baltà-Salvador, R., Olmedo-Torre, N., Peña, M., & Renta-Davids, A.-I. (2021). Academic and emotional effects of online learning during the COVID-19 pandemic on engineering students. *Education and Information Technologies*, *26*, 7407–7434.

Battussi, F., & Chittaro, L. (2017). Effects of Different Types of Virtual Reality Display on Presence and Learning in a Safety Training Scenario. *IEEE Transactions on Visualization and Computer Graphics*, *24*(2), 1063–1076.

BBC. (2021). *Apparently, it's the next big thing. What is the metaverse?* https://www.bbc.com/news/technology-58749529.

Bell, I. H., Nicholas, J., Alvarez-Jimenez, M., & Thompson, A. (2020). Virtual reality as a clinical tool in mental health research and practice. *Dialogues in Clinical Neuroscience*, *22*(2), 169–177.

Bernd, S. (2001). *Wissensmedien im Bildungssektor: Eine Akzeptanzuntersuchung an Hochschulen [Knowledge media in the education sector: An acceptance study at universities] [Doctoral thesis]* (Dissertation, WU Vienna University of Economics and Business). Retrieved from https://epub.wu.ac.at/1869/

Bixter, M. T., Blocker, K. A., Mitzner, T. L., Prakash, A., & Rogers, W. A. (2019). Understanding the use and non-use of social communication technologies by older adults: A qualitative test and extension of the UTAUT model. *Gerontechnology*, *18*(2), 70–88.

Bliss, J. P., Tidwell, P. D., & Guest, M. A. (1997). The Effectiveness of Virtual Reality for Administering Spatial Navigation Training to Firefighters. *Presence: Teleoperators and Virtual Environments*, *6*(1), 73–86.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. doi: 10.1191/1478088706qp063oa

Burdea, G. C., & Coiffet, P. (2003). *Virtual Reality Technology* (2nd ed.). New York, John Wiley & Sons Incorporated.

Carlson, P., Peters, A., Gilbert, S. B., Vance, J. M., & Luse, A. (2015). Virtual Training: Learning Transfer of Assembly Tasks. *IEEE Transactions on Visualization and Computergraphics*, *21*(6), 770–782.

Chahal, J., & Rani, N. (2022). Exploring the acceptance for e-learning among higher education students in India: combining technology acceptance model with external variables. *Journal of Computing in Higher Education*.

Charmaz, K. (1996). The search for meanings - Grounded theory. In J. A. Smith, R. Harré, & L. van Langenhove (Eds.), *Rethinking methods in Psychology* (pp. 27–49). SAGE Publications.

Cochrane, T. (2016). Mobile VR in Education: From the Fringe to the Mainstream. *International Journal of Mobile and Blended Learning*, *8*(4), 44–60.

Concannon, B. J., Esmail, S., & Roduta Roberts, M. (2019). Head-Mounted Display Virtual Reality in Post-secondary Education and Skill Training. *Frontiers in Education*, *4*.

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, *13*(3), 319–340.

Disztinger, P., Schlögl, S., & Groth, A. (2017). Technology acceptance of virtual reality for travel planning. In R. Schegg & B. Stangl (Eds.), *Information and communication technologies in tourism 2017* (pp. 255–268). Springer.

Freina, L., & Ott, M. (Eds.). (2015). A literature review on immersive virtual reality in education: State of the art and perspectives. *Proceeding of the International Scientifc Conference in E-learning and Software for Education. Bucharest.*.

Fussell, S. G., & Truong, D. (2022). Using virtual reality for dynamic learning: an extended technology acceptance model. *Virtual Reality*, *26*, 249–267.

Gharaibeh, M. K., Arshad, M. R., & Gharaibeh, N. K. (2018). Using the UTAUT2 Model to Determine Factors Affecting Adoption of Mobile Banking Services: A Qualitative Approach. *International Journal of Interactive Mobile Technologies (iJIM)*, *12*(4), 123–134.

Gierdowski, D. C. (2019). *ECAR Study of Undergraduate Students and Information Technology, 2019. Educause Center for Analysis and Research.* https://library.educause.edu/resources/2019/10/2019-study-of-undergraduate-students-and-information-technology.

Guilbault, M. (2016). Students as customers in higher education: reframing the debate. *Journal of Marketing for Higher Education*, *26*(2), 132–142.

Hennink, M. M. (2014). *Focus group discussions*. Oxford University Press.

Huang, H.-M., Liaw, S.-S., & Lai, C.-M. (2016). Exploring learner acceptance of the use of virtual reality in medical education: a case study of desktop and projection-based display systems. *Interactive Learning Environments*, *24*(1), 3–19.

Jang, S., Vitale, J. M., Jyung, R. W., & Black, J. B. (2017). Direct manipulation is better than passive viewing for learning anatomy in a three-dimensional virtual reality environment. *Computers & Education*, *106*, 150–165.

Janzik, R. (2022). *Mediennutzung und Virtuelle Realität: Erklärungsfaktoren der Akzeptanz und Nutzung von Virtual Reality im privaten Kontext*. Berlin, Springer.

Jayaram, S., Jayaram, U., Kim, Y. J., DeChenne, C., Lyons, K. W., Palmer, C., & Mitsui, T. (2007). Industry case studies in the use of immersive virtual assembly. *Virtual Reality*, *11*, 217–228.

Jennett, C., Cox, A. L., Cairns, P., Dhoparee, S., Epps, A., Tijs, T., & Walton, A. (2008). Measuring and defining the experience of immersion in games. *International Journal of Human-Computer Studies*, *66*(9), 641–661.

Kavanagh, S., Luxton-Reilly, A., Wuensche, B., & Plimmer, B. (2017). A systematic review of Virtual Reality in education. *Themes in Science & Technology Education*, *10*(2), 85–119.

Kong, S. C., Chan, T.-W., Griffin, P., Hoppe, U., Huang, R., Kinshuk, ... Yu, S. (2014). E-learning in School Education in the Coming 10 Years for Developing 21st Century Skills: Critical Research Issues and Policy Implications. *Educational Technology & Society*, *17*(1), 70–78.

Li, C., Liang, W., Quigley, C., Zhao, Y., & Yu, L.-F. (2017). Earthquake Safety Training through Virtual Drills. *IEEE Transactions on Visualization and Computergraphics*, *23*(4), 1275–1284.

Liang, H., Chang, J., Deng, S., Chen, C., Tong, R., & Zhang, J. J. (2017). Exploitation of multiplayer interaction and development of virtual puppetry storytelling using gesture control and stereoscopic devices. *Computer Animation and Virtual Worlds*, *28*(5).

Majid, F. A., & Shamsudin, N. M. (2019). Identifying Factors Affecting Acceptance of Virtual Reality in Classrooms Based on Technology Acceptance Model (TAM). *Asian Journal of University Education*, *15*(2), 51–60.

Meta Quest. (2021). *Horizon workrooms - remote collaboration reimagined [Video]. YouTube.* https://www.youtube.com/watch?v=lgj50IxRrKQ.

Milgram, P., & Kishino, F. (1994). A Taxonomy of Mixed Reality Visual Displays. *IEICE Transactions on Information Systems*, *E77-D*(12), 1321–

1329.
Molan, S., Weber, D., & Kor, M. (2022). Shaping children's knowledge and response to bushfire through use of an immersive virtual learning environment. *Journal of Educational Computing Research*.
Murcia-Lopez, M., & Steed, A. (2018). A Comparison of Virtual and Physical Training Transfer of Bimanual Assembly Tasks. *IEEE transactions on visualization and computer graphics*, *24*(4), 1574–1583.
Noble, S. M., Saville, J. D., & Foster, L. L. (2022). VR as a choice: what drives learners' technology acceptance? *International Journal of Educational Technology in Higher Education*, *19*(6).
Parong, J., & Mayer, R. E. (2018). Learning science in immersive virtual reality. *Journal of Educational Psychology*, *110*(6), 785–797.
Pettey, C. (2018). *3 reasons why VR and AR are slow to take off. Gartner.* https://www.gartner.com/smarterwithgartner/3-reasons-why-vr-and-ar-are-slow-to-take-off.
Pulijala, Y., Ma, M., Pears, M., Peebles, D., & Ayoub, A. (2018). Effectiveness of Immersive Virtual Reality in Surgical Training-A Randomized Control Trial. *Journal of oral and maxillofacial surgery : official journal of the American Association of Oral and Maxillofacial Surgeons*, *76*(5), 1065–1072.
Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education*, *147*, 103778.
Ragan, E. D., Bowman, D. A., Kopper, R., Stinson, C., Scerbo, S., & McMahan, R. P. (2015). Effects of Field of View and Visual Complexity on Virtual Reality Training Effectiveness for a Visual Scanning Task. *IEEE Transactions on Visualization and Computer Graphics*, *21*(7), 794–807.
Ragan, E. D., Sowndararajan, A., Kopper, R., & Bowman, D. A. (2010). The Effects of Higher Levels of Immersion on Procedure Memorization Performance and Implications for Educational Virtual Environments. *Presence: Teleoperators and Virtual Environments*, *19*(6), 527–543.
Rebelo, F., Noriega, P., Duarte, E., & Soares, M. (2012). Using virtual reality to assess user experience. *Human factors*, *54*(6), 964–982.
Robinson, O. C. (2014). Sampling in Interview-Based Qualitative Research: A Theoretical and Practical Guide. *Qualitative Research in Psychology*, *11*(1), 25–41.
Sagnier, C., Loup-Escande, E., Lourdeaux, D., Thouvenin, I., & Valléry, G. (2020). User Acceptance of Virtual Reality: An Extended Technology Acceptance Model. *International Journal of Human–Computer Interaction*, *36*(11), 993–1007.
Saunders, M. N., Lewis, P., & Thornhill, A. (2019). *Research methods for business students* (8th ed.). Pearson.
Shen, C.-w., Ho, J.-t., Kuo, T.-C., & Luon, T. H. (Eds.). (2017). Behavioral Intention of Using Virtual Reality in Learning. *Proceedings of the 26th International Conference on World Wide Web Companion*, 129–137.
Slater, M., & Wilbur, S. (1997). A Framework for Immersive Virtual Environments (FIVE): Speculations on the Role of Presence in Virtual Environments. *Presence: Teleoperators and Virtual Environments*, *6*(6), 603–616.
Spatial. (2021). *Telepresence with Spatial vs. Video Conferencing.* https://spatial.io/blog/telepresence-vs-videoconferencing.
Statista. (2021). *Consumer virtual reality (VR) head mounted display (HMD) device shipments worldwide from 2020 to 2025.* https://www.statista.com/statistics/1222854/worldwide-virtual-reality-head-mounted-display-shipments/.
Sutherland, I. E. (1965). The Ultimate Display. *Proceedings of the IFIPS Congress*, *65*(2), 506–508.
Taherdoost, H. (2018). A review of technology acceptance and adoption models and theories. *Procedia Manufacturing*, *22*, 960–967.
Tamilmani, K., Rana, N. P., & Dwivedi, Y. K. (2017). A systematic review of citations of UTAUT2 article and its usage rrends. *Lecture Notes in Computer Science (pp. 38-49). Springer*.
Taylor, S., & Todd, P. (1995). Assessing IT Usage: The Role of Prior Experience. *MIS Quarterly*, *19*(4), 561–570.
Toyoda, R., Abegao, F. R., Gill, S., & Glassey, J. (Eds.). (2021). *Drivers of immersive virtual reality adoption intention: a multi-group analysis in chemical industry settings*.
Vaughn, S., Schumm, J. S., & Sinagub, J. (1996). *Focus Group Interviews in Education and Psychology*. SAGE Publications.
Velev, D., & Zlateva, P. (2017). Virtual Reality Challenges in Education and Training. *International Journal of Learning and Teaching*, *3*(1), 33–37.
Venkatesh, V., & Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science*, *46*(2), 186–204.
Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, *27*(3), 425–478.
Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly*, *36*(1), 157–178.
Ventura, S., Brivio, E., Riva, G., & Baños, R. M. (2019). Immersive Versus Non-immersive Experience: Exploring the Feasibility of Memory Assessment Through 360° Technology. *Frontiers in Psychology*, *10*, 2509.
Wang, P., Wu, P., Wang, J., Chi, H.-L., & Wang, X. (2018). A Critical Review of the Use of Virtual Reality in Construction Engineering Education and Training. *International Journal of Environmental Research and Public Health*, *15*(6), 1204.
Witmer, B. G., & Singer, M. J. (1998). Measuring Presence in Virtual Environments: A Presence Questionnaire. *Presence: Teleoperators and Virtual Environments*, *7*(3), 225–240.
Yan, Y., Chen, K., Xie, Y., Song, Y., & Liu, Y. (2019). The effects of weight on comfort of virtual reality devices. In F. Rebelo & M. Soares (Eds.), *Advances in Ergonomics in Design. Proceedings of the AHFE 2018 International Conference on Ergonomics in Design, USA* (pp. 239–248). Springer.
Yin, R. K. (2011). *Qualitative Research from Start to Finish*. The Guilford Press.
Zakaria, M. A., Abuhassna, H., & Ravindaran, K. (2020). Virtual Reality Acceptance in Classrooms: A Case Study in Teaching Science. *International Journal of Advanced Trends in Computer Science and Engineering*, *9*(2), 1280–1294.
Zhang, W. (2014). On College Oral English Teaching in the Base of Virtual Reality Technology. *Applied Mechanics and Materials*, *687-691*, 2427–2430.