An Extended UTAUT2 model to Explain the Adoption of Virtual Reality Technology in Health Centers: An Empirical Study Based in Riyadh

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Abstract
The adoption of new technology in any organization will represent change, and such change needs user acceptance for its successful implementation. Saudi Arabian health centers are no exception; therefore, the current study will investigate the adoption of new technology, namely that of virtual reality (VR), within health centers in Saudi Arabia and specifically in Riyadh City. This study explores the current state of VR technology adoption, factors that influence such adoption, and the extent of this technology's efficiency when it is used for vaccinating children. The data were collected from two samples: workers in vaccination clinics who responded to a survey and a group of children who participated in the VR technology experiment. The current study proposed a model based on the unified theory of acceptance and use of technology 2 (UTAUT2), with the addition of two variables: personal innovativeness and satisfaction. The results indicated that the respondents' perceptions regarding the health centers' infrastructure in terms of adopting VR were moderate. Among the factors affecting VR adoption, satisfaction, personal innovativeness, and behavioral intention were identified as vastly influential factors. From the eight hypotheses, six were found to be supported, with their factors significantly influencing behavioral intention with regard to VR technology adoption. Besides, the experiment concerning the use of VR technology on children verified the technique's high efficiency in terms of providing pain management and fear removal. These findings support the continuity of VR technology use, expand its future application fields, and integrate this study into the literature on technology acceptance models for VR adoption, as limited studies have covered this topic; consequently, this will benefit future research in this field.
Keywords:
Technology Adoption; Virtual Reality; UTAUT2; Health Centers

1. Introduction

Given that the continuous improvement of technology has a significant impact on many areas of our daily lives, many organizations adopt new technologies to improve the efficiency and effectiveness of different work processes [1]. However, introducing new technologies within organizations is not a straightforward task, and the adoption of new systems is often faced with a lot of resistance [2]. So, the extent of the user acceptance of the new technology is essential to implementing such a technology smoothly. In general, acceptance is defined as "antagonism to the term refusal and means the positive decision to use an innovation" [3]. In the information systems field, the adoption of technology is still an interesting topic. Many types of research are conducted to measure the user acceptance of technology adoption. As it is one of the most exciting topics in this field, this research will investigate the adoption of a new type of technology—virtual reality (VR) technology—in health centers in Riyadh. VR technology provides a multisensory and three-dimensional (3D) environment that enables users to become fully immersed in a simulated world [4]. Moreover, VR technology is defined as an emerging technology with a variety of uses, ranging from clinical research to the assessment and treatment of several medical and psychological conditions [5]. Several models and frameworks have been developed to explain the user adoption of new technologies, and these models introduce factors that can affect user acceptance [3]. In this research, the unified theory of acceptance and use of technology 2 (UTAUT2) model is extended to include two more constructs to investigate VR technology adoption.

In 2018, the Ministry of Health (MOH) in Saudi Arabia began using VR technology to control children's fear while vaccinating procedures in various health centers in Saudi Arabia, including some in Riyadh. The MOH seeks to accomplish a promising future vision in Saudi Arabia, namely, delivering the best quality integrated and comprehensive healthcare services [6]. Information technology has played a vital role in the innovation of healthcare systems [7]. As VR is new in healthcare sectors in Saudi Arabia, it is necessary to investigate the user acceptance of adopting VR technology and factors that influence such adoption. Furthermore, understanding the technology adoption process can guide innovation to improve treatments and ease the transition into a digital workflow [8]. In Saudi Arabia, no study has investigated the efficiency of VR technology in relation to vaccinating children; besides, no study has yet investigated the impact of personal innovativeness and satisfaction, as an extension

Manuscript received March 5, 2021
Manuscript revised March 20, 2021
https://doi.org/10.22937/IJCSNS.2021.21.3.30

of the UTAUT2, on VR technology acceptance. According to [9], the UTAUT2 will be more appropriate for constructing the conceptual model which all of its determinants were significant in the intention to use technology. Therefore, the current study aims to fill this research gap by integrating these constructs into the UTAUT2 framework regarding the acceptance of VR adoption in healthcare centers and determining VR efficiency in a group of children.

The main questions of this research are as follows:

RQ1. What is the current state of VR adoption in health centers?

RQ2. What factors influence the adoption of VR technology?

RQ3. What is the extent of the efficiency of VR technology in terms of vaccinating children?

2. Literature Review

2.1 Virtual Reality Technology

There are three types of VR systems: non-immersive systems, semi-immersive projection systems, and fully immersive head-mounted displays. Non-immersive systems are the least immersive among VR techniques because they only utilize a portal window to view the virtual environment. Keyboards, mice, and trackballs are used to interact in the virtual environment. Semi-immersive projection systems provide a broader sense of presence when compared to non-immersive systems because they use large screen monitors, big screen projector systems, or multiple television projection systems, which enhance the user's feeling of immersion [10]. But among the three types of VR systems, fully immersive Head Mounted Display (HMD) systems provide the most direct experience of the virtual environment [11]. The first device that provided immersive experiences with computer-generated imagery was the HMD, which was invented in the mid-1960s. Several studies have discussed the implementation of VR in different fields, including the healthcare sector.

The first healthcare applications of VR started in the early 1990s due to the need for medical staff to visualize complex medical data [12]. The benefits of VR in healthcare comprise many fields associated with medical/surgical training, counseling, preventative medicine, and the architectural design of modern hospitals [13]. Recent research suggests that VR has proven to be useful in medicine as a more effective method of exposure therapy for patients with post-traumatic stress disorder and to treat pain during the opioid addiction epidemic [14]. VR technology has also been progressively utilized in healthcare for teaching medical students, providing training to new staff members, and revitalizing the trade skills of medical professionals [13].

VR can be used as an educational tool for medical staff. For instance, a study conducted at the Cincinnati Children's Hospital Medical Center on pediatric residents decreased influenza vaccine refusal rates through the use of VR and the teaching of communication skills. The participants of this study included postgraduate-level and pediatric residents. This study's result contributed positively to reducing the rate of influenza vaccine refusal [15].

Moreover, vaccine injections cause pain, which makes people hesitant about vaccination during their lifespans [16]. Refraining from vaccination could be hazardous to the community and an individual's immunization and could lead to vaccine-preventable diseases. Individuals' noncompliance behaviors regarding vaccinations may result from their fear of needles or negative vaccination experiences [17]. Several evidence-based treatments have been developed to mitigate pain during vaccinations; however, most are rarely used [18]. Overall, 67% of studies in the reviews of the impact of VR on pain demonstrated a statistically significant reduction in pain during virtual reality utilization [19].

A study on 38 children aged between 6 months to 7 years old aimed to examine the effect of a water-friendly Projector-Based Hybrid Virtual Reality. The results showed that Projector-Based hybrid VR helped reduce the pain related to hydrotherapy procedures in young children with burn wound injuries [20]. Besides, few studies investigated the use of virtual studies in mitigating the pain in children during vaccinations as most parents do not postpone or skip injections for their children as a result of concerns about pain [21].

For instance, a study was conducted in California to check whether VR reduces pain or not. It found that using VR for 30 seconds before, during, and after a vaccination led to a 45%–74% decrease in the degree of pain experienced by children while receiving the seasonal influenza vaccination [22].

A similar study conducted by Silverberg, and La Puma [23] found that using VR during vaccinations reduced children's fear of future injections and vaccinations. A group of researchers developed VR-based software for lowering pain levels among children at Benioff Children's Hospital in San Francisco. The software reduced pain intensity by 16% and reduced pain descriptors by 33% among 25 children and young adults. The pain was measured using the Adolescent Pediatric Pain Tool [24].

However, almost all technologies such as VR suffer from some form of public criticism due to their unpleasant effects on the environment and the lives of people or due to the frequency and duration of their use [25]. Due to the exploitation of such technologies, several reports have implied that users might experience unwanted physical, physiological, and psychological side effects.

In terms of VR equipment, physical problems may arise due to the interaction techniques used in the systems, such as headset weight and fit are among the most significant problems found among fully immersive systems utilizing HMD because they are relatively big and bulky. They can also cause discomfort and strain on the neck if improperly fitted. Additional pressure on the neck can be experienced by a user who is not moving, and additional inertia provided by the HMD should be considered when the user performs a head movement [26]. Virtual equipment can be covered in airborne pathogens and bacteria from skin flora. HMDs can also cause sweating because they are fully covered, and the displays produce a high amount of heat [27].

A fully immersive HMD can also pose a risk of injury because the user is functionally blind in the real world while wearing one. Collisions with real-world objects or VR system cabling might occur as a result of the immersive scene, which could distract the attention of the user even though he/she has some external vision [27].

Among all the side effects produced by VR systems, little is known about the psychological effects. Some research suggests that people may become obsessed with VR, like those who play computer games. The use of VR equipment can be compared to people who are obsessed with their hobbies. Hallucinations, dissociation, literalization, and retreat from reality are some of the behavioral effects of VR [28].

2.2 Technology Acceptance Models

According to the literature, several models and frameworks have been developed to measure the user acceptance of modern technology. A number of theories, including the theory of reasoned action, the diffusion of innovations theory, the theory of planned behavior, the technology acceptance model, the combined of Technology Acceptance Model (TAM), and Theory of Planned Behavior (TPB), the motivational model, the model of PC utilization, and social cognitive theory, have been developed and used to explain the intention to use and use of new technologies [29]. Figure 1 shows many models and theories of technology acceptance and how some of the theories and models have extended other theories [3].

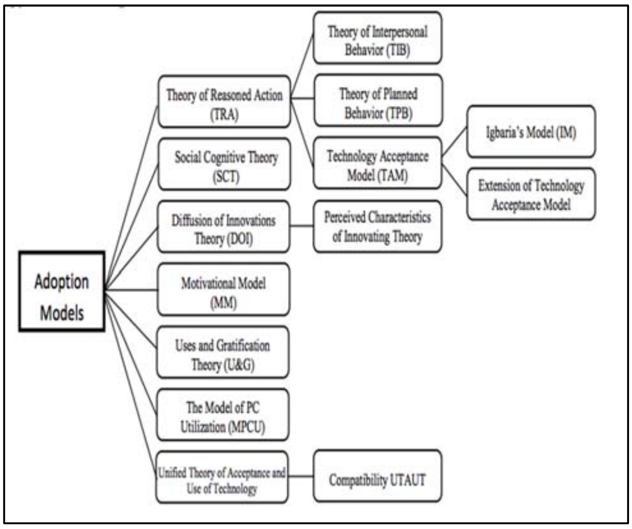

Fig. 1 An Overview of Adoption / Acceptance Models.

2.2.1 UTAUT2: Unified Theory of Acceptance and Use of Technology 2

The UTAUT2 model was developed based on findings from studies using the UTAUT model. So, the UTAUT2 was created as a comprehensive, integrated model to better understand consumer acceptance of new technology or systems [30]. The UTAUT2 model resulted in the addition of three new factors to the basic UTAUT model, which are as follows:

- Price value
- Habit
- Hedonic motivation

Most previous studies depended on either the UTAUT or UTAUT2 to investigate the adoption of certain technologies. However, when the researcher applied the UTAUT2 to the medical context to explain the adoption of VR technology in health centers, the model needed additional development. Therefore, the researcher conducted some quick interviews with medical cadres, where the mentioned different factors would influence their willingness to use virtual reality, such as personal innovativeness and satisfaction. Besides, the previous studies emphasize these factors' high level of influence on technology adoption and behavioral intention. Thus, the need for developing the UTAUT2 was clear. Furthermore, to ensure the accuracy of the factors provided in this study, the researcher reviewed some related literature. It was found that Kim and Ko [31] stressed the satisfaction factor when adopting VR techniques. Regarding personal innovativeness, Wei, Qi, and Zhang [32] stated that it represents an essential component of technology adoption.

Consequently, the researcher added these factors to the current UTAUT2 model and developed the research tool accordingly.

2.3 Conceptual Framework

The proposed theoretical framework includes performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), hedonic motivation (HM), habit (HA), behavioral intention (BI), personal innovativeness (PI), and satisfaction (SA). Several hypotheses were developed based on the proposed framework, and, as clearly presented in figure 2, behavioral intention is hypothesized to be affected by the following independent variables: performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, habit, personal innovativeness, and satisfaction. Demographic data were collected based on age, gender, experience, and educational level. BI was selected as a dependent variable in this study.

The independent variable of the UTAUT2 model, price value (PV), was not included in this study's proposed framework because of VR technology being provided by the MOH to health centers free of charge. Figure 2 shows the proposed theoretical framework for VR adoption.

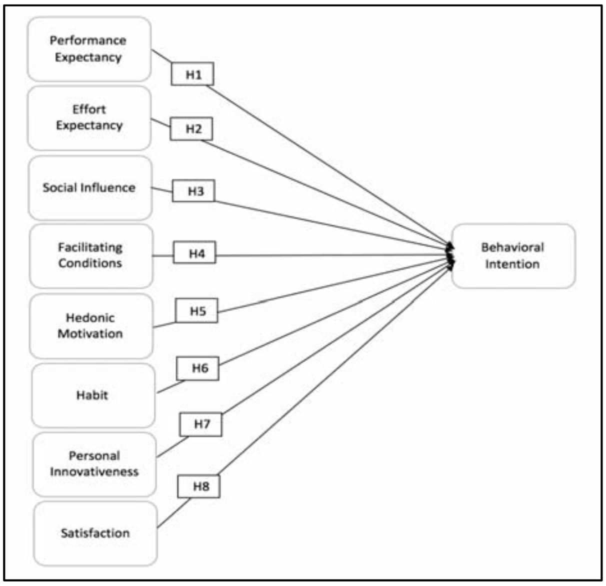

Fig. 2 Proposed Theoretical Framework for VR Technology Adoption.

2.4 Developing Research Hypotheses

This section presents the hypothesized relationships developed based on the factors. The above figure illustrates the proposed framework; it includes eight constructs that affect BI.

Performance expectancy is defined as the degree to which an individual believes that using the system will help him/her to attain one's work goals. Three factors that affect the PE are PU, extrinsic motivation, and job fit. Within each of the individual models tested, the variables related to PE were the strongest predictors of intention to use the target technology [9]. According to [33], Venkatesh et al. indicate that the PE construct is the strongest predictor of the BI to use new technology. Therefore, the following hypothesis is proposed:

H1 Performance expectancy will positively influence the behavioral intention to use VR technology.

Effort expectancy is defined as "the degree of ease associated with the use of the system" [33]. According to [33], EE was derived from the perceived ease of use factor, as proposed in the TAM. Previous studies have suggested that EE has a strong influence on users' intentions in relation to technology adoption and acceptance. For this reason, this study proposes the following hypothesis:

H2 Effort expectancy will positively influence the behavioral intention to use VR technology.

Social influence is defined as the extent to which others' opinions influence an individual's intention to use the technology, mostly with regard to that individual's network of family and friends [33]. Many recent technology acceptance studies have incorporated this construct into their operational models and found some empirical support for it [34]. Lu et al. have found that SI has a substantial impact on users' intentions to adopt technology [34]. SI is further recognized as one of the four direct determinants of BI to use, together with PE, EE, and FC [33]. Accordingly, the following hypothesis is put forward:

H3 Social influence will positively influence the behavioral intention to use VR technology.

Facilitating conditions are defined as the degree to which an individual believes that organizational and technical infrastructure exists to support the use of the system [33]. According to [35], they found that FC is a direct determinant of BI and the use of technology. FC is expected to have a positive impact on the BI to use VR technology.

H4 Facilitating conditions will positively influence the behavioral intention to use VR technology.

Hedonic motivation is defined as the fun or pleasure derived from using technology, and it has been shown to play an essential role in determining technology acceptance and use [36]. Thus, HM is expected to influence BI.

H5 Hedonic motivation will positively influence the behavioral intention to use VR technology.

Habit was defined by Limayem et al. [37] as the extent to which people tend to automatically perform behaviors because of learning. According to [36], HA has a statistically significant influence on users' BI. For this reason, the following hypothesis is developed:

H6 Habit will positively influence the behavioral intention to use VR technology.

Personal innovativeness has, in general, in innovation diffusion research, long been recognized as the idea that highly innovative individuals are active information seekers of new ideas [34]. So, highly innovative people will be more willing to acquire new technologies and will learn to use them more effortlessly. According to previous studies, PI has a positive impact on technology adoption. In this study, highly innovative people will affect the BI to use VR technology in health centers. Thus, the following hypothesis is formulated:

H7 Personal innovativeness will positively influence the behavioral intention to use VR technology.

Satisfaction is defined as the overall feeling of the user when using a system or service [38]. SA has a statistically significant impact on users' BI, as corroborated by Chao, C. M [39]. As a result, an eighth hypothesis is developed:

H8 Satisfaction will positively influence the behavioral intention to use VR technology.

3. Research Methodology

This research is concerned with examining VR technology's adoption in relation to vaccination clinic employees and pain management in children. A group of pediatric patients whose treatment plans consisted of vaccinations was selected for the study. The children were randomly divided into two groups—experimental and control. Children with any visual or auditory defects and patients who could not communicate efficiently due to language barriers were excluded from the study. Furthermore, those that had a previous invasive, painful medical history were also excluded. Informed written consent was obtained from the parents before the start of the procedure. The children in the experimental group were shown the VR eyewear and had its workings explained to them before beginning the treatment. The VR eyewear was put on the patient, and the video was started, which, in addition to serving as a distraction technique, was also amusing. Once the child was engrossed in the video, the treatment was started: vaccination procedure. Children in the control group received similar procedures without the use of the VR distraction. At the end of the treatment, children were shown faces on a pain scale and they were asked to point to the face that best showed the amount of pain perceived by them during the treatment.

Besides, an online survey based on the extension of the UTAUT2 was distributed to workers in vaccination clinics in health centers in Riyadh. The survey data were used to test the hypotheses and generalize the research. The survey consisted of three sections, and the obtained data were given to an independent statistician and subjected to blinded statistical analysis.

So, the data were collected from the two samples using two different methods. Initially, with regard to the children, the VR eyewear experiment was randomly conducted in four health centers in December 2020 on a group of children aged between four and six years old. The experiment was performed over three rounds, with two children in each round—one in the control group and the other in the experimental group. The faces pain scale was shown to the children during the treatment, they were asked to choose from the five levels of pain (1 = no pain, 2 = mild pain, 3 = moderate pain, 4 = intense pain, and 5 = unspeakable pain), and the researcher collected these data.

In the second sample, which included workers from vaccination clinics in the 91 health centers in Riyadh, the data were collected using the modified UTAUT2 questionnaire as mentioned in [36]. The researcher modified the questionnaire questions and added two additional factors based on the objectives and target population of the study. To validate the questionnaire, the researcher offered it to six computer information systems experts and one statistical analyst, and according to their reviews, the questionnaire was modified. Then, the researcher requested the approval of the questionnaire from the Ethics Committee in the first and second clusters of health centers before it was used.

Furthermore, to validate the survey's questions and scales, a pilot survey was distributed randomly through email and personal visits. Thirty-one responses were received from November 2 to November 20, 2020, which demonstrated that all the questionnaire items were valid and reliable as shown in the following two tables. The data from the pilot survey were not included in the main study. The study's main survey was similarly distributed through email and personal visits from November 22, 2020 to January 15, 2021, and 191 responses, where excluded 5 of them due to incomplete data. All the participants were informed about the study's purpose, confidentiality protection, and the anonymity of the collected data, which would only be used for academic purposes. To check the study tool validity, the researcher calculated a Pearson correlation coefficient for each item and the total score of each dimension. The results of the total score are shown in tables 1. Moreover, to check the reliability of the study tool, the researcher used Cronbach's alpha stability coefficients, as shown in table 2. The total stability coefficient value (alpha) amounted to 0.977, which demonstrates a high degree of stability. The study tool's stability coefficients ranged between 0.769 and 0.937, which are considered to be high and trustworthy when applying the present study.

Table 1: Pearson Correlations for the Total Score of the Dimension (n=31).

Dimension	Pearson correlation	Dimension	Pearson correlation
Current Infrastructure	.682**	**HM**	.820**
PE	.800**	**HA**	.941**
EE	.852**	**PI**	.915**
SI	.887**	**SA**	.899**
FC	.961**	**BI**	.871**

****. Correlation is significant at the 0.01 level**

Table 2: Cronbach's Alphas for Measuring the Study Tool Stability (n=31).

Dimension	Reliability coefficient	Dimension	Reliability coefficient
Current Infrastructure	.0.846	**HM**	0.769
PE	.0.887	**HA**	0.904
EE	.0.914	**PI**	0.948
SI	0.902	**SA**	0.907
FC	0.867	**BI**	0.937
Overall Reliability			0.977

4. Results and Discussion

4.1 The Study Questions

According to the survey findings, 62.9% of the respondents were female, and more than half of them were aged between 26 and 35 years old. Moreover, most of the respondents had bachelor's degrees (74.7%) and between 5 and 15 years of experience; most of them were nurses. The other part of the sample consisted of 24 children aged between 4 and 6 years old: 15 boys and 9 girls.

Table 3: The Distribution of the Overall Study Sample According to Demographic Characteristics(n=186).

Selected Characteristic		Frequency	Percent
Gender	Male	69	37.1
	Female	117	62.9
Age	18-25 years	20	10.8
	26-35 years	104	55.9
Educational level	36-50 years	62	33.3
	Diploma	40	21.5
	Bachelor degree	139	74.7
	Postgraduate	7	3.8
Experience	less than 1 year	15	8.1
	1-5 years	78	41.9
	5-15 years	81	43.5
	over 15 years	12	6.5
Position	Medical doctor	69	37.1
	Nurse	117	62.9
Using VR technology	Yes	141	75.8
	No	45	24.2

Regarding the first question on VR technology infrastructure, the results showed that the perceptions of the respondents in terms of the current state of VR adoption in health centers were moderate, with a mean score of 3.39 ± 0.51, which indicated that the infrastructure of the health centers in Riyadh is ready to incorporate VR technology; most of the respondents agreed that internet connection provided, but they also pointed out that support from health center leaders with regard to supplying the necessary equipment and encouraging staff to use it was neutral. Besides, technical and maintenance assistance for health centers in Riyadh was identified as neutral. In Saudi Arabia, health centers are funded and managed by the MOH, which is keen to keep up to date with modern technology. That is why most respondents agreed upon the readiness of health centers' infrastructure in terms of adopting VR technology.

Moreover, the findings of the second question demonstrated that the respondents agree about the factors influencing the adoption of VR technology, with a mean score of 4.10 ± 0.27. The results illustrated that there are different levels of factors, ranked high to low, that influence the adoption of VR technology. Initially, as shown in the results, SA seems to be the most influential factor in terms of adopting VR technology. According to previous literature, a higher level of user SA will mostly impact the user adoption of technology. For instance, one study emphasized the strong influence of SA on the user adoption of cloud-based e-learning [40]. Another example provided support for the effect of SA constructs on the adoption of m-learning systems [39]. The result of this study confirms the previous findings on the influence of the SA construct on technology adoption. Furthermore, PI was found to be the second most vital factor that influences the adoption of VR technology. Such a result was also found by Alrawi, M. A. S., GanthanNarayanaSamy, R. Y., Shanmugam, B., Lakshmiganthan, R., & NurazeanMaarop, and N. K. when examining factors that influence the acceptance of mobile commerce, and they found that PI was one of the most influential factors [41]. According to [41], a highly innovative person will significantly impact the acceptance of a new system or technology. In addition, BI was ranked as the third most influential factor. This result is consistent with existing literature in the information systems field, and [33,36] indicated that BI had been largely and repeatedly reported to have a vital role in shaping the actual usage and adoption of new systems or technology in the prior information systems and information technology literature. Finally, SI was the lowest ranked influencing factor, and the same result was found in other studies, which disproves the hypothesized high impact of SI on the adoption of technology. For example, a study found that SI did not significantly influence user intention to use e-books [42]. To summarize, the overall perceptions of respondents regarding the factors that influence the adoption of VR technology are shown in table 4.

Moreover, an open-ended survey question indicated some useful suggestions for adopting VR technology in health centers in Riyadh, such as the provision of technical and maintenance staff in health centers. According to [43], “there are some technical problems in implementing VR technology in healthcare not yet overcome”. So, those involved may face obstacles during the implementation of VR technology, or they may experience hardware malfunctions; for that reason, support is crucial. Some respondents indicated the importance of spreading knowledge in the community because many people do not know about VR technology. Thus, there is a need to spread awareness about the importance of such technology in medicine and its possible contributions to achieving positive outcomes. Furthermore, one respondent stated that VR technology should be widely used and not only limited to vaccination clinics. It is the MOH’s responsibility to provide permanent encouragement for hospitals with regard to using VR technology and expanding their fields as the use of such technology will contribute to the achievement of Saudi Arabia Vision 2030.

Table 4: The Perceptions of Respondents Concerning the Factors that Influence the Adoption of VR Technology (n=186).

Dimensions	Mean	SD	ranking
Performance Expectancy	4.23	0.38	6
Effort Expectancy	4.29	0.35	4
Social Influence	3.33	0.57	9
Facilitating Conditions	4.08	0.41	7
Hedonic Motivation	4.27	0.46	5
Habit	3.55	0.46	8
Personal Innovativeness	4.38	0.45	2
Satisfaction	4.47	0.48	1
Behavioral Intention	4.34	0.51	3
Overall mean	4.10	0.27	-

Furthermore, the third question’s findings illustrated that VR technology is somewhat efficient in terms of vaccinating children; this was represented through a reduction in the levels of pain and fear reported by children in the experimental sample. This result is similar to those of previous experiments that have proven the efficiency of VR concerning pain reduction [20,21,22]. According to [23], a similar study confirmed VR technology’s efficiency in relation to removing children’s fear during vaccinations. The Mann-Whitney test was used to find out the extent of the efficiency of VR technology in relation to vaccinating children.

4.2 The Study Hypotheses

Most of the previous research clarified that the independent variables have a different level of influence on the dependent variable. In this study, the independent variables are PE, EE, SI, FC, HM, HA, PI, and SA, and the dependent variable is BI. The results showed that all the proposed hypotheses were supported except for two: H3, which predicted that SI would positively influence the BI to use VR technology, and H6, which envisioned that HA would positively influence the BI to use VR technology. According to the results, the most influential variable with regard to the BI to adopt VR technology was SA, as it was the most influential factor of adopting VR technology. In this study, a highly satisfied person highly affects the BI to adopt VR technology. As found in the previous results, Satisfaction has a significant impact on BI to adopt new technology, such as a study that aims to predict the factors affecting students' behavioral intentions toward using mobile learning which examine Satisfaction construct, and the result was confirmed its significant impact on BI to adopt technology[39]. From the successful model's information systems perspective, user satisfaction can significantly influence individuals' BI to use a particular system [44]. The next most significant factors affecting the BI to adopt VR technology were PE and HM. This finding supports research results that show that PE and HM significantly impact BI [33,36]. In this context, VR technology helps the workers in vaccination clinics provide services to many patients and increases the quality of their work. Moreover, it is considered to be an enjoyable and entertaining technology. PI was ranked as the third most influential factor on the BI to adopt VR technology. This confirmed the effect of PI on BI found in the previous literature, as mentioned in [34] that Innovativeness is linked to BI to adopt the technology. This factor was followed by FC, for which the hypothesis was supported in terms of adopting VR technology. Some research supports the effect of FC on the BI to adopt technology [33,35]. The lowest ranked influential factor with regard to the BI to adopt VR technology was EE. Unfortunately, the third and sixth hypotheses were not supported, and SI and HA were not found to influence the BI to adopt VR technology. For instance, the same result of SI does not influence BI was found in a study that aims to discover the factors that influence users in using e-commerce [45]. Another study aimed to analyze factors that influence customer behavior's intention in using technology services by using the UTAUT 2 model found that did not support the same hypothesis of the effect of HA on BI [46]. In this study, the reason for the lack of support for these two hypotheses may be that VR technology is new in health centers, so people are not used to using it on a daily basis and not everyone in the community knows about it.

5. Conclusion

Technology today represents an attractive area and has many potential uses; therefore, it needs to be investigated further to get more insights into user acceptance and its future development. In this context, VR technology adoption was the topic selected to be explored, motivated by the few studies covering this area. Besides, there was a need to address a theoretical model to analyze the user acceptance of VR technology in Saudi Arabia. Therefore, a recent theoretical model, the UTAUT2, was selected to propose a theoretical framework by including two additional factors, PI and SA, as they were cited in the literature review as being among the most influential factors in terms of technology adoption. The validity and reliability of the proposed model were verified. Furthermore, to better understand the real use of VR technology on children, the experiment was conducted during vaccination procedures. The results showed that the participants' perceptions regarding the readiness of health centers' infrastructure to adopt VR technology were moderate, with a mean score of 3.39 ± 0.51. Moreover, factors such as SA, PI, and BI were the most influential factors with regard to VR technology adoption. In contrast, HA and SI seem to be less influential in terms of adopting VR technology. Besides, six of this study's hypotheses were supported, while two of them were not. The influences of SA, PE, and PI were the three most significant in relation to BI, while SI and HA did not significantly influence the BI to adopt VR technology. Finally, the VR technology experiment achieved positive pain management results on children and helped remove their fear.

This study has a couple of limitations, which provide opportunities for future research. First, the Price Value construct was not included in this study because VR technology is provided free of charge by the MOH. Future research should include all the UTAUT2 constructs. Second, data were only collected from health centers in one city in Saudi Arabia, and this could impact the generalizability of the results in relation to other cities. A suggestion for future work is to expand the geographical area to cover more than one city. Third, this study only covers the adoption of VR technology in vaccination clinics in health centers in pain management, which could reduce this study's applicability to other clinics, other fields, and private hospitals. Future research should cover different clinics and include private and public hospitals. Fourth, 186 survey responses were analyzed after excluding some due to incomplete data. If the response rate had been larger, the BI to use VR technology could have a significant different finding for the health centers. Besides, the children's sample size was also small due to limited health centers in Riyadh that use VR technology and the restriction imposed by using children aged between 4 and 6 years old, meaning that it took a long time to collect the required data. For this reason, future research should expand the sample size to get more general results. Moreover, there is a lack of previous literature that used technology acceptance models to determine the user acceptance of VR technology in the medical field; as a result, the current study will contribute to the body of literature in this field and suggest future research to fill this gap. As a final point, moderator variables, such as age and gender, could be included in future research to analyze their effect on the proposed framework.

Acknowledgments

I want to acknowledge the support provided by my supervisor Prof. Abdullah Altameem and co_supervisor, Prof. Abdul Rauf Baig, through their guidance, feedback, and valuable knowledge to complete this research. I would also like to acknowledge Imam Mohammed Ibn Saud Islamic University for their student's care by providing them free access to a digital library, which is considered the largest source of academic information in the Arab world. Finally, a special thanks to my family, my mother, and my partner for their continuous help and support during my years of study and research process, as this accomplishment would not have been possible without them.

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